*The*
*GEOGRAPHICAL JOURNAL*

*Vol LXXIX No 5* R.G.S. *May 1932*

## THE BRITISH ARCTIC AIR ROUTE EXPEDITION: *A paper read at the Special Evening Meeting of the Society on 12 December 1931, by*

H. G. WATKINS

THE object of the British Arctic Air Route Expedition was to investigate the possibilities of an air route between England and Canada across the Arctic *via* the Faeroes, Iceland, Greenland, Baffin Island, and Hudson Bay. The advantage of this route over the direct crossing of the Atlantic would be that a long and dangerous sea crossing would be avoided and the distance would be less, since the Arctic Route would practically follow the Great Circle route between Scotland and Winnipeg.

The least-known part of the proposed route was the east coast and central Ice Cap of Greenland. The whole of the interior of Greenland consists of an ice plateau rising to the height in the centre of between 8000 and 9000 feet. In some places this plateau comes down to the sea along the coast, but in most places there is a coastal mountain belt between the Ice Cap and the sea.

On the east coast there are only two settlements, one at Scoresby Sound of about one hundred Eskimos, and one at Angmagssalik of seven hundred and seventy Eskimos. The most likely place for the proposed air route to cross the east coast seemed to be somewhere near Angmagssalik, and it was decided that the expedition should have its base within 50 miles of this settlement. It was planned to keep continuous meteorological records at the base and to establish another station for the same purpose on the highest point of the Ice Cap between Angmagssalik and the west coast. Long journeys were to be made over the Ice Cap in various directions in order to find its height and to study its weather conditions. Also, it was hoped that it would be possible to map a long stretch of the coast and the coastal mountain belt, both north and south of Angmagssalik; and lastly, if time and the conditions permitted, a flight was to be made along the route between England and Canada.

The committee of the expedition consisted of Major Stephen Courtauld, Chairman; Captain R. Rayner, Secretary; Mr. A. Courtauld, Treasurer; Mr. J. M. Wordie, Mr. Holt, and Mr. H. G. Watkins.

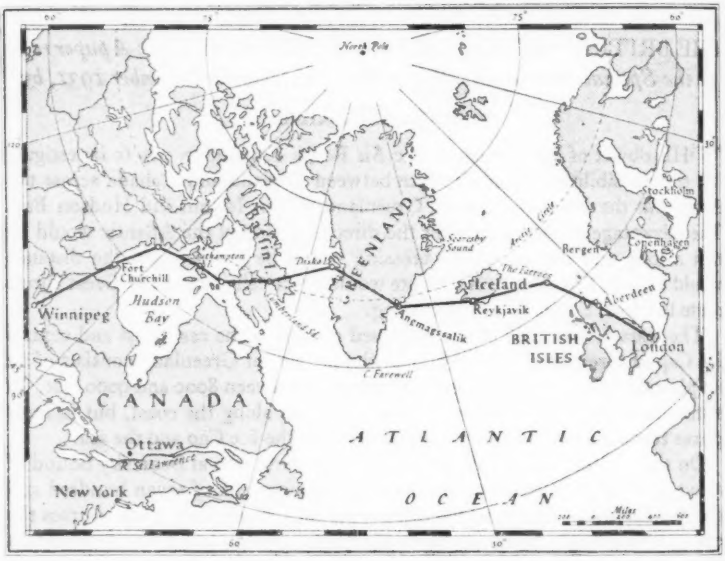
The expedition was financed by Major Stephen Courtauld and Mr. Holt, and also by the very generous help of the Courtauld family, especially Mr. Augustine Courtauld, and other private subscriptions. The Royal Geo-

graphical Society gave a very generous grant of money and also lent instruments. Various Government departments helped by lending personnel and instruments, and many firms assisted by giving quantities of food and equipment to the expedition, Bovril, Ltd., giving a grant of £100 to the expedition funds.

It will be best to start with a brief summary of the work and journeys done by the expedition in Greenland. This list will make the narrative easier to follow.

The base was on the east coast of Greenland, about 40 miles west of the island of Angmagssalik.

*1st Journey.*—Survey of the coast from Angmagssalik to Kangerdlugsuak. This was done in the summer of 1930. The *Quest*, motor boats, and a sea-




*Proposed British Arctic Air Route*

plane were used. About 200 miles of coast-line were mapped and a strip of air photographs of this whole coast-line was taken. These photographs are oblique and take in most of the mountain country between the sea and the Ice Cap. A high range of mountains was discovered just north of Kangerdlugsuak. Apart from the mapping, a careful geological and ornithological survey was made on this journey.

*2nd Journey.*—A journey was made in September and October 1930 on the Ice Cap. The party went 125 miles inland in a north-west direction from the base. From here the party turned south and followed the highest part of the Ice Cap for 100 miles, then turned out to the coast and back to the base. A careful record of the height of the Ice Cap was kept and meteorological observations were made throughout the journey. Total length of journey, about 370 miles.

*3rd Journey*.—An attempt to reach Kangerdlugsuak by sledge in the early spring, 1931. This failed owing to the bad blizzard.

*4th Journey*.—To the Mount Forel district (about 100 miles north of the base) in late spring. This journey resulted in the survey of the mountain region surrounding Mount Forel, an accurate determination of its height, and an attempt to climb it. The party did not reach the top, but succeeded in reaching the highest point ever attained in the Arctic. A geological study was made in this region and meteorological observations were kept on the whole journey. Total length of journey, about 360 miles.

*5th Journey*.—The crossing of the Ice Cap from the base to Ivigtut on the south-west coast, July 1931. The journey was made down the eastern edge of the Ice Cap as far as Umivik, and thence across to Ivigtut. Height observations were kept the whole time, also meteorological observations. Several new nunataks were discovered. Total length of journey, about 500 miles.

*6th Journey*.—Across the Ice Cap from the base to Holsteinsborg on the west coast, late summer, 1931. Height observations and meteorological observations were kept the whole time. The journey also demonstrated the possibility of a new form of travel, as Eskimo kayaks were carried across the Ice Cap on the sledges so that the party could reach the settlement (a journey of about 90 miles by sea from the edge of the Ice Cap). Total length of journey, about 470 miles.

*7th Journey*.—From the base round the south-east coast of Greenland to Julianehaab on the west coast. Detailed mapping was done on the first 140 miles of the journey (as far as Umivik). A strip of air photographs had already been taken from the base to Umivik. These photographs were used for filling in detail on the ground survey. An island about 40 miles long was discovered. A new method of arctic summer travel was used. The journey was done in two 18-foot boats fitted with outboard engines. Since petrol for 600 miles had to be carried, very little food could be taken. Instead of food kayaks were taken and food for the journey was secured by hunting seals with the kayaks and harpoons. Total length of journey, about 560 miles.

Apart from these journeys, a careful survey was made of the district round the base and also the southern part of Sermilik Fjord, and air photographs were taken of all this country. Detailed geological and ornithological work was also done round the base and Angmagssalik. Meteorological observations were kept at the base for the whole year.

A station was established on the highest part of the Ice Cap between the base and the west coast. This was about 125 miles from the base. Continuous meteorological observations were kept at this station for seven months.

Flying was carried out during the summer and winter, for the purpose of reconnaissance, air photography, and transport of supplies.

The expedition consisted of fourteen men: H. G. Watkins, leader; J. M. Scott, in charge of sledge dogs; A. Courtauld, surveyor; Captain P. Lemon, R.E., wireless officer; Flight-Lieut. N. H. D'Aeth, R.A.F., chief pilot; Surgeon Lieut. Bingham, R.N., medical officer; A. Stephenson, chief surveyor; L. R. Wager, geologist; J. R. Rymill, surveyor; F. S. Chapman, ornithologist; Q. Riley,

meteorologist; W. E. Hampton, engineer and second pilot; Flight-Lieut. I. Cozens, R.A.F., photographer; Lieut. M. Lindsay, Royal Scots Fusiliers, surveyor.

We left St. Katherine's Dock on 6 July 1930, in Sir Ernest Shackleton's old ship, the *Quest*. This ship had been chartered from its Norwegian owners and was manned by a Norwegian crew under Captain Schjelderup. After coaling at Blythe we went straight to Vaag Fjord, in the Faeroe Islands, to pick up our sledge dogs. These had been bought in West Greenland earlier in the year and brought back to the Faeroe Islands by Scott. We found our fifty dogs in excellent condition on board a barge anchored off Captain Ejnar Mikkelsen's whaling station in Vaag Fjord. Scott had not been allowed to land them as there are many sheep on the islands. One dog had however managed to escape and swim ashore, and in the few hours before it was shot it had killed nine sheep. Before taking the dogs on board we built a pen forward of the bridge so that they should not be swept overboard. We took in a large quantity of fresh whale meat for ourselves and hung enough dried meat in the rigging to last the dogs until we reached Greenland. We then left for Reykjavik, our last port of call.

We eventually got into the ice some distance north-east of Angmagssalik on July 21. The ice was fairly open, so that we had no difficulty in reaching Angmagssalik. We stayed only one day in order to discuss with the minister, Pastor Rosing, the possibility of finding a suitable place for our base near the settlement. It was necessary to find a place where there was an easy approach to the Ice Cap, where there was likelihood of plenty of open water for our seaplanes, where it was easy to land our stores, and where we could get fresh water. We eventually found a place which suited all requirements except the last. All our water had to be brought from a stream some distance from the hut. This place was about 40 miles west of the main Angmagssalik settlement, Tasiusak.

As soon as we had decided on the place for our house we started unloading our stores. We worked in two shifts so that the unloading could go on day and night. Everything had to be lowered from the *Quest* into small boats, then rowed ashore and carried up to a level patch of ground. Apart from the material for the house, the instruments, aeroplanes, food, and sledging equipment, there were also 15 tons of coal to be landed. It took us fourteen days from the time we started work until the last case was landed and the hut finished and the seaplane ready to fly.

When this was done we were free to start preparations for the first journey. This was for the purpose of establishing the Ice Cap station on the highest part of the Ice Cap between our base and the west coast of Greenland. A preliminary reconnaissance on foot and a couple of flights in the seaplane had shown the best route from the fjord to the Ice Cap.

First of all the dogs had to be taken across the fjord from our base to a glacier from the Ice Cap. Then all stores had to be carried a mile over scree up to a level part of the glacier where sledging could begin. This carrying was done by all members of the expedition, and it was not until everything was deposited on the glacier that we said good-bye to the party and returned to the *Quest*.

*Establishing the Ice Cap Station*

The sledging party consisted of Scott, Rymill, Bingham, Riley, and Lindsay. The party left the lower end of the glacier on August 11. The first 2 miles was

*Drift ice on approach to Angmagssalik*

*"Quest" lying at base: approach to Ice Cap across fjord*

*Blizzard from Ice Cap gradually approaching base*

*Blizzard from Ice Cap gradually approaching base*

up a fairly steep glacier. At the head of this glacier was a very steep bank of ice about 500 feet high. Camp was made at the bottom of this bank and light loads were taken up on the sledges. Only one sledge was taken up at a time as the bank was so steep and slippery that neither the men nor the dogs could get a good footing. It took two and a half days getting the loads to the top of the bank.

The next 10 miles was the most difficult part of the whole journey. The country was cut up by crevasses as the ice was falling fairly rapidly from the level interior of the Ice Cap. It was necessary for roped parties to go ahead on skis to find a suitable way, and even then it was often necessary for the whole sledge party to retrace its footsteps for half a day on being confronted by a particularly bad stretch of crevassed country. To add to the other difficulties, it was thawing, consequently the snow was sodden and there were many rivers on the ice. Everything soon got soaking wet.

A week after leaving the lower end of the glacier the party reached the more level part of the Ice Cap at a height of 3960 feet, and 15 miles from the sea. A large flag was put up at this point in order to mark the end of the crevassed country. (Later we established a food depot here, and the spot was known as the Big Flag depot.) From here they were able to travel in a straight line, since there were no crevasses to be avoided. They travelled on a bearing of 319°, aiming to establish the station on the highest part of the Ice Cap between our base and the west coast. Small red flags were put up every half mile, and compass bearings were taken on these. The distance was measured with a sledge wheel and every now and then latitude and longitude observations were taken to check the position. The loads on the sledges were heavy and extremely awkward owing to the meteorological instruments for the Ice Cap station and to the weight of the station house itself. The surface was fairly hard, so that it was possible to walk some of the time without skis or snowshoes.

From the Big Flag depot it was found that the Ice Cap rose in a series of long steps towards the centre. Apart from these steps the surface was not level but undulating, so that it is never possible to see very far in any direction. About 10 miles beyond the Big Flag depot they lost sight of the coastal mountains. When they were 30 miles farther on they saw a range of high mountains about 100 miles to the north-east. This was the Switzerland range seen by De Quervain on his crossing of Greenland. Mount Forel could be seen high above all the others (De Quervain had found its height to be about 11,000 feet).

On August 29 the party reached a suitable place for the station. They took a great deal of care to establish it on the highest part of the Ice Cap between our base and the west coast and also on the direct line between our base and Disko Island on the west coast, which would be one leg of the proposed air line between England and Canada. The station house consisted of a dome-shaped tent of canvas stretched over a wooden frame. It was of double thickness with an air space between the two layers of canvas. In the roof there was a small ventilating shaft. There was no entrance through the sides of the tent, but a tunnel was dug so that the entrance was underground. Since the entrance was below floor-level none of the warm air could escape except through the ventilating shaft, and ventilation could be altered as desired. The height of the Ice Cap at this point was 8200 feet above the sea. Food, paraffin,

and instruments were left at the station, and Riley and Lindsay remained to take the observations for the first month.

On August 30 Scott, Rymill, and Bingham started home. Conditions on the return journey were good, and they were able to ride on the sledges. They arrived at the base on September 3.

The weather on the whole journey had been extremely variable. Frequently a start would be made in the early morning in extremely fine weather, and two hours later there would be fine snow falling out of an apparently cloudless sky. There was a light wind most of the time from the north-west, and on their return journey they saw from the state of the snow at the Big Flag that there had been an extremely strong blizzard from the north-west during their absence; the wind had reached a speed of 60 m.p.h. at the base.

The whole journey was made very efficiently. Scott was the only member of the party who had ever sledged or used dogs before. In spite of this, each man had his own sledge and team of seven dogs. With their heavy and awkward loads they averaged 10 miles a day on their journey from the Big Flag depot to the Ice Cap station (this includes the time spent in their tents during bad weather, and also the time spent taking the observations). They did the return journey from the Ice Cap station to the base in four and a half days, an average of 28 miles per day.

*The First Journey: Angmagssalik to Kangerdlugsuak*

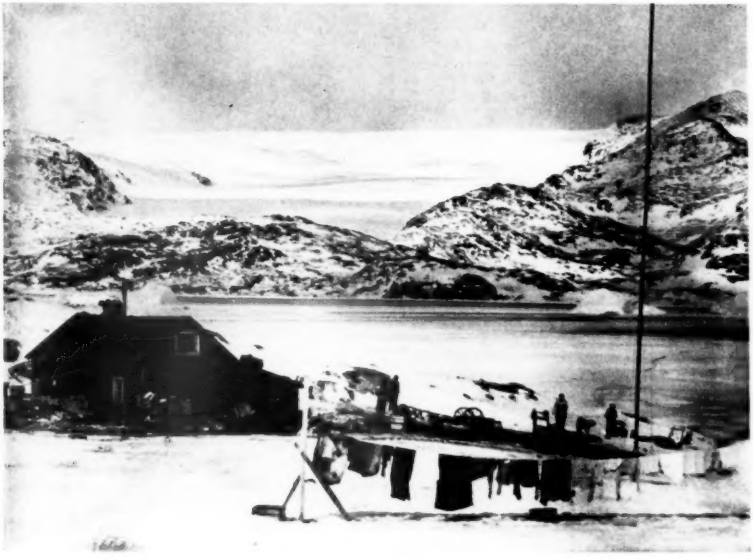
While this journey was in progress the rest of the expedition had been engaged in other work. Captain Lemon had remained at the base alone to put things in order and to get the wireless station going. The rest of us had gone off in the *Quest* to map the coast north of our base.

In 1901 a Danish expedition under Amdrup had come down this coast in a boat from Cape Dalton. They had been able to map the main features but, owing to the bad ice conditions, they could not get right into the coast-line in one or two places. At one point, 280 miles north of our base, they had come to the entrance of a large fjord. They were unable to enter it owing to the ice, but judged it to be extremely large. This fjord was known to the Eskimo, who had visited it many years before and named it Kangerdlugsuak. The Danish party were unable to map the coast immediately south of this fjord, owing to the ice conditions.

On our proposed survey of this coast we hoped to reach Kangerdlugsuak and map it, and possibly map the coast to the north. In any case, we determined to do a detailed survey of the whole coast-line between Kangerdlugsuak and our base. A full account of this journey will appear in a later number of the *Journal*, and I will now only briefly outline the work done.

We started up the coast on the *Quest* and found the ice very open. We stopped halfway between our base and Kangerdlugsuak to take air photographs of the coast from our seaplane. We then continued in the *Quest* to Kangerdlugsuak, which we reached without any particular difficulty. We went to the head of the fjord and put down a depot in the hope that we should be able to sledge to this point in the winter. We found that the fjord was about 40 miles long and 10 miles wide at the mouth. We managed to find a fairly ice-free fjord just north of Kangerdlugsuak, where we could use our seaplane.

*Lake at head of Lake Fjord: flying base for air photography*



*Route across fjord to Bugbear Bank*

*Aeroplane on skis at base*

*Aeroplane on skis at base*

From here we were able to complete the strip of photographs of the coast-line between us and our base. On one flight at Kangerdlugsuak we saw a high range of mountains about 40 miles north of this fjord. We judged their height to be between 12,000 and 15,000 feet, in which case they would be the highest known mountains in the Arctic. Unfortunately, we were never able to get near them to make sure of this height.

When we had completed the strip of air photographs, D'Aeth and I flew back to the base, leaving a party to work down the coast in the *Quest* in order to do a careful survey of the coast southwards. This party consisted of Courtauld, Stephenson, Wager, Chapman, Hampton, and Cozens. The survey was a plane-table survey supplemented by detail filled in from the air photographs. They worked slowly down the coast, and reached the base on September 15. Wager and Chapman were doing geological and ornithological work.

The result of this journey was a detailed survey of Kangerdlugsuak and the coast-line between that fjord and Sermiligak (a fjord just north of Angmagssalik), and a strip of oblique air photographs of the whole coast, showing in most cases the coast-line itself and the mountain country in as far as the Ice Cap.

*The Second Journey: Centre of Ice Cap*

As soon as D'Aeth and I returned in the seaplane from Kangerdlugsuak and Scott's party arrived at the base after having established the Ice Cap station, preparations were started for the southern journey. The plan was to start from the Big Flag depot and follow the outside edge of the Ice Cap southward in order to map the edge of the coastal mountain belt; then to slant across to the highest point of that part of the Ice Cap, and follow it northwards to the Ice Cap station, and from there follow the ordinary route out to the base. The journey was to be undertaken by Scott and myself with Bingham and D'Aeth as supporting party for the first two weeks.

We left the base on September 15 and had the assistance of a large supporting party for the first few miles of difficult country. The edge of the Ice Cap was extremely rough owing to melting earlier in the summer, but luckily most of the snow had already melted and the surface was fairly dry. We reached the Big Flag depot on September 20. Here we decided on a change of plan. Instead of travelling down the outside edge of the Ice Cap and up the centre to the Ice Cap station, we decided to go straight in to the station and then travel southward from there and return by the coast. In this way we should avoid facing directly into the prevailing wind on our return journey. There was a relief party due to start in to the Ice Cap station in a few days, but we decided not to wait for them; since there were only two men in their party, we knew they would catch us up after a few days. The surface of the Ice Cap was softer than on Scott's earlier journey, and we had to wear snowshoes and skis all the time. On October 2 we reached the Ice Cap station in company with the relief party, consisting of Chapman and Rymill, who had joined us about halfway along the route.

At the Ice Cap station we found Riley and Lindsay, who had been doing the meteorological observations for the last month and a half and generally getting the station in order. They had built a wall round the house and had also built two Eskimo type snow houses as storerooms and for the various relief parties

to live in while at the station. The lowest temperature they had recorded during this stay had been —27° Fahrenheit.

At the Ice Cap station we again decided on a change of plan. Instead of taking Bingham and D'Aeth on with us as supporting party we decided that they should remain at the station instead of Riley and Lindsay, who would go back to the base with Rymill and Chapman, and that the food of the supporting party should not be used for our journey but should go to increase the supply at the Ice Cap station. This change of plan meant that we could not get as far south as we had hoped, but we thought that we might be able to reach the line of Nansen's crossing from Umivik to Godthaab.

We soon found that conditions on the centre of the Ice Cap were worse than we had anticipated. The snow was soft and deep, so that the dogs sank in often to their shoulders. We had not yet had time to train the dogs to single-trace driving, so that we were driving them in Eskimo or fan method. Each dog has a separate trace and they spread out in a fan. Although this method is good on hard sea-ice, it is useless on soft snow, as each dog has to make his own track. On single-trace driving the front dogs make the track and the rest can get a good pull. Owing to the soft snow and fan driving we could do only short distances each day. The surface of the Ice Cap is not level, but consists of a series of circular hills about 100 feet in height and 2 miles from crest to crest, so that one is nearly always either going up or down hill. We found that the level of the Ice Cap gradually falls to the south of our station.

About a week after we left the Ice Cap station we got a bad blizzard which lasted a day and a half. In a few days we had another blizzard and they got more frequent as time went on, so after we had gone 100 miles south we decided to turn out to the coast. We eventually reached the steep crevassed edges of the Ice Cap near the head of Ikersuak, and here the blizzards became more frequent. Sometimes we could travel only for one day between them, and would remain in our tents for two or three days at a time. On November 11 we reached the line of flags from the base to the Ice Cap station, and met a relief party under Chapman on its way in to the station. From here it took us one day to the base, which we reached on November 12, after a 350-mile journey.

The weather at the beginning of the trip had been good, but for the last few weeks there had been many blizzards. But the most surprising thing was the temperature. We had expected cold weather on the journey and had gone prepared for it. Actually we had not one low temperature. About —40° Fahrenheit was the lowest on the journey, so that we never had to trouble to build snow houses and could use single down sleeping bags, weighing 2½ lb.

*Ice Cap Station: First Relief*

While we had been away on this journey Stephenson had been surveying the country round the base, and there had been the relief journey to the Ice Cap station already mentioned. This was undertaken by Chapman and Rymill, and it is not necessary to describe it in detail. They left the base on September 21 and reached the station on October 2, averaging 12·3 miles a day from the Big Flag depot to the Ice Cap station. Bingham and D'Aeth were left at the station; Riley and Lindsay came out from the station with Chapman and Rymill, and

on October 13 they reached the Big Flag depot. The weather on the journey up was good, but on the return they encountered the first of the bad Ice Cap blizzards. They had no low temperatures during the whole journey.

*Ice Cap Station: Second Relief*

On October 27 a party set out from the base to relieve Bingham and D'Aeth, who were at the Ice Cap station. Before this party left the blizzards from the Ice Cap had started to blow with fair regularity once or twice a week. The first of these blizzards reached a speed of 129 miles an hour at the base before it broke the wind gauge; after that it blew even harder. Before leaving England the Air Ministry had told us that there was an average of about one gale every ten years at Angmagssalik, and as a consequence of this we had considered that it would be possible to make journeys to the Ice Cap station all the winter. We knew that the temperatures would not be low enough to stop travel. As a consequence of the first blizzards we saw that repeated journeys to the Ice Cap station during the winter would be impossible.

The party which left the base at the end of October to relieve the station consisted of Chapman, Courtauld, Wager, Lemon, Stephenson, and Hampton. They had a supporting party for the first few miles. They had a large amount of food and paraffin with them for the Ice Cap station, and one sledge load consisting entirely of wireless equipment, as it was proposed to have wireless communication between the Ice Cap station and the base.

From the start of the journey they had extremely bad weather conditions. The first night on the glacier they had to pitch their tents on hard ice free from snow. A blizzard sprang up and blew away one tent. After that they had a blizzard every few days and sometimes had to remain in their tents for two or three days at a time.

Owing to the terrible weather the 15 miles from the base to the Big Flag depot took fifteen days. Two days later they met Scott and myself on the way back from the southern journey. It was obvious to Chapman that reorganization was necessary, and he asked me if he might leave the wireless behind and send back three men so that he could take a larger quantity of dog food, and so make certain of reaching the station. I told him to do this and anything else he thought necessary.

Next day Chapman made a depot of all the wireless stores and sent back Lemon, Stephenson, and Hampton with a small amount of man food and no dog food. These three men arrived back at the base in four days, losing one dog on the way. Chapman, Courtauld, and Wager went on towards the Ice Cap station with fully loaded sledges. The weather was very bad: blizzards every few days. These blizzards always came from the north-west and usually lasted two days. After a blizzard it sometimes took the party four or five hours to dig out their sledges and equipment which had got buried under the snow. For the last part of the journey they got better conditions and were able to travel for four consecutive days. They also had a bright moon and so were able to travel after the sun had set. Eventually, after thirty-nine days' travelling, they reached the Ice Cap station on December 3.

Owing to the length of time they had taken to reach the station they had not as much food and paraffin to leave there as had been intended. Chapman had

three courses open to him: (1) He could leave two men at the station. Owing to the supply of food these men would have to be relieved early in March. It was obvious that these blizzards might last until the end of March, so he decided against this course; (2) he might leave one man alone. This man would have food and paraffin until May; (3) he might abandon the station altogether.

Before we had left England I had stated that during the year it would probably be necessary to have one man alone at the station. I have travelled with the trappers of Labrador, who are alone sometimes for eight or nine months, travelling in a much more difficult kind of country than the Greenland Ice Cap. Nothing ever goes wrong with these men through being alone, and indeed there is no reason why it should, since a man travelling alone is always faster and more efficient than he is when travelling with a companion.

Courtauld volunteered to remain alone at the Ice Cap station in order to do the meteorological observations during the winter. He wrote to me stating that he had ample provisions until May but that he would like to be relieved before that if possible.

On December 6 Chapman, Wager, Bingham, and D'Aeth started home. Owing to the terrific blizzards the surface of the Ice Cap was cut up by iron-hard snowdrifts. Going over these drifts was a big strain on the sledges, and on the journey up all of them had started to break. They had been mended at the Ice Cap station, but on the return they started to break up again, so that they had to be mended every evening. The dogs had to be fed on very low rations, since on arrival at the Ice Cap station only two days' dog food was left. The rest of the food for the return had to be made up from the man food. Towards the end of the journey they began to run out of paraffin, candles, and man food, and eventually arrived at the base on December 19 with practically no provisions of any sort left. The whole journey from the base to the Ice Cap station and back again had taken them fifty-four days. Although they had never had very cold weather they had had appalling travelling conditions with repeated blizzards on both the outward and return journey. The lowest temperature reached on this journey was 49° F. higher than we had expected at this time of year.

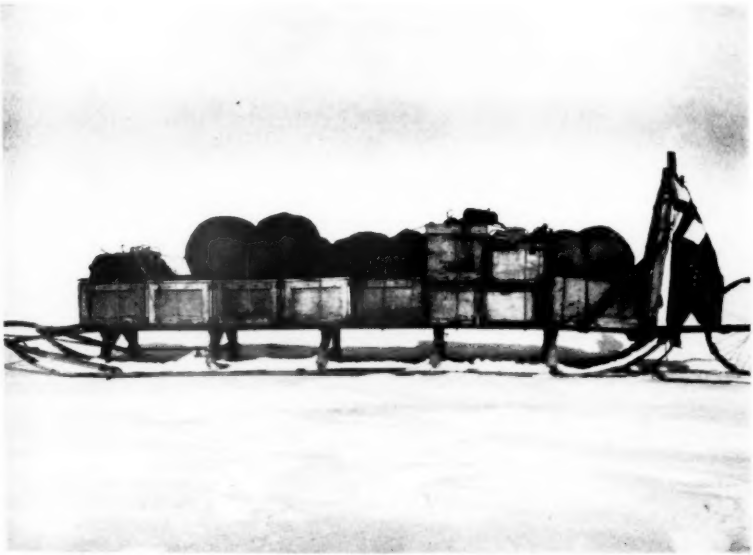
In spite of the hard going the party reached the base in good condition, except for D'Aeth, who had frost-bitten fingers and also frost-bitten toes. This was chiefly due to the fact that there was a shortage of moccasins, and he was wearing fur boots which are only good for temperatures down to about —30° F. After that the ordinary thin Indian type of moccasins is the only thing to wear. This is well known to the Eskimos, who very seldom get frost-bitten feet.

This journey was very hard and extremely well carried out, in spite of the fact that none of the party had had any previous experience of Arctic winter travel.

*Winter at the Base*

When Chapman's party got back we settled down to winter life at the base. Owing to the blizzards winter travel on the Ice Cap was not possible. But we had hoped during the winter to do a journey south to map the coast as far as

*Hoisting sledge up Bugbear Bank with block and tackle*



*Loaded sledge: about 700 lb. for team of seven dogs*

*Sledging up Bugbear Bank*

*Sledging up Bugbear Bank*

Umivik, 140 miles from the base. We also hoped to be able to map Sermilik Fjord, the 60-miles-long fjord just north of our base. Unfortunately the coast survey to Umivik had to be abandoned altogether, and the survey of Sermilik was only partially completed. Travel in both these directions was prevented by open water. As soon as ice formed on the big fjords it was broken up by the blizzards, so that although one could travel about 20 miles north and south of our base on the coast, longer journeys were impossible owing to the open water on the big fjords. However we were able to do various short journeys. Arctic winter coastal travel is a very much more difficult business than the Ice Cap travel at any time of year.

On an ice-cap journey the only difficulties to be found are the weather, crevasses, and rough ice (near the edge). Driving dogs on the Ice Cap is a simple matter; in fact it cannot really be called dog driving, any more than walking on skis on the Ice Cap can be called ski running. In Arctic coast travel it is necessary to have an accurate knowledge of the thickness of ice which will carry the weight of a man on skis or without them, of a lightly loaded sledge and heavily loaded sledge. This thickness will, of course, vary as you go up a fjord, since the water at the head of a fjord is always fresher than at the mouth, and freshwater ice has a different strength from salt-water ice. Then in the spring, when the ice is beginning to melt, it is necessary to know the places where the ice is likely to have been cut away from underneath by currents, and later great skill is required to sledge over drifting ice-pans. The rough ice met with in pressure ridges on coast travel is far worse than any rough ice which is ever found on the Greenland Ice Cap.

Owing to open water it is frequently necessary to cross the points of land on a coast journey rather than go round them, and this necessitates travel in steep mountainous country. Lastly, on a coast journey, owing to the rough nature of the country, it is usually impossible to carry more than a few days' food, so that a knowledge of Eskimo hunting methods is necessary in order to secure food for the journey. Owing to the varied nature of coastal travel it takes a man about three or four seasons' experience of driving different types of dogs through different types of country before he can be a really experienced coastal dog sledger, whereas a man can learn to drive dogs successfully on the Greenland Ice Cap in a few days.

Apart from the various small journeys round the base for survey purposes, most of our time during the winter was occupied in hunting in order to get fresh meat for ourselves and the dogs. Most of our meat however came from an Eskimo settlement about 20 miles south of our base, where hunting conditions were very good and where they always had a surplus of food. In winter the Eskimos hunt seals in various ways, but the most common method at Angmagssalik is to stand along the edge of the open water and shoot them when they swim along near the ice. Practically no skill is required in this method other than straight shooting, and the Eskimo who gets most seals is the man who goes out most often or who has the best rifle. Later in the year various methods of harpoon-hunting are used. This requires more skill, but the spring hunting is the most difficult, although this does not compare in difficulty with the summer kayak hunting. In spring the seals come out of their breathing holes on to the ice and bask in the sun. While a seal is basking in the sun it will

usually sleep for about thirty seconds, then wake up and look about for five seconds, and then sleep again for thirty seconds.

It is possible to use two methods for hunting a seal on the ice. In the first method dark clothes are worn and the hunter wriggles up to the seal while pretending to be a seal himself. This is a very slow method, taking sometimes two or three hours to approach a seal. In the second method, which is quicker, the man creeps up to the seal behind a white screen. He only moves while the seal is sleeping, and if the seal gets disturbed he has to remain in one place until it is quiet again. A good hunter can always get to within 25 yards of a seal. He then shoots it in the head and immediately runs towards it to catch it, since the impact of the bullet will often set it sliding down the inclined plane of ice into its hole and it will be lost under the ice.

There is one method of harpoon-hunting which is only found among the Eskimos of Greenland: the long harpoon method. A harpoon about 20 feet long is used that has a detachable head fastened to a sealskin line which is held in the hand of the hunter. The harpoon is painted black so that it does not show in the water. Two holes are cut through the ice, one small, the other about a foot across. Two little bone spinners are attached to the head of the harpoon and it is then put through the hole so that it projects about 10 feet below the ice. One hunter stands up and slowly twirls the harpoon between his hands so as to move the bone spinners. The other hunter lies down with a black hood over his head (so as to keep out the light) and peers down into the water, making a peculiar hissing noise with his mouth. When a seal, attracted by the noise and the bone spinners, comes to look at the head of the harpoon, the hunter, who is lying down, waits until the seal is directly under the point of the harpoon, then shouts "tauva" (now), and the other hunter plunges the harpoon down into the seal. The head of the harpoon becomes detached from the shaft, and the hunter than holds the seal on the line. If it is a large seal he may have a good struggle to bring it to the surface. Meanwhile the other hunter enlarges the hole in the ice so that the seal can be brought out.

During the winter Hampton and D'Aeth transferred our "Moth" from floats to skis, so that we could fly from the sea-ice. Several flights were made over to the main Angmagssalik settlement for various purchases. We had hoped that we should be able to drop some luxuries and letters to Courtauld at the Ice Cap station, and for this purpose we made several flights, but none of them was successful. The Ice Cap station was marked only by a small flag, and since the whole surface of the Ice Cap is covered with snowdrifts which cast black shadows, it would be possible to fly right over the station without seeing it. Also navigation in a small machine over the Ice Cap is difficult, especially since the direction of the wind changes the farther you get in from the coast. Unfortunately D'Aeth was unable to fly much during the winter, owing to a broken arm.

When possible, after every flight the aeroplane was put away in the hangar; when it was not possible it was securely fastened down to the ice. On one flight to the main Angmagssalik settlement Cozens left the plane out at night fastened to the ice. A blizzard sprang up and broke up the ice on which the aeroplane was standing and smashed up the plane. Hampton flew over next day in the other machine to look at the wreck. He decided that it might be

*Ice Cap Station: dome tent and tents of relief party, Autumn 1930*

*Ice Cap Station as found 5 May 1931*

*Sledging camp on Ice Cap route: half-mile flag*

*Sledging camp on Ice Cap route: half-mile flag*

mended, and so he and Rymill set to work. They worked about ten hours a day under very unpleasant conditions for about six weeks, and succeeded in building a new aeroplane out of the wreck of the old machine and bits of driftwood and canvas. Cozens flew spare parts over to them from the base and other spare parts were taken over by sledges. On one of the flights the machine on landing hit an ice crack which knocked the undercarriage up into the fuselage, so that as soon as Hampton and Rymill had finished mending one machine they had to start on the other. It would be impossible to praise their work too highly.

*Ice Cap Station: Third Relief*

From December 6 Courtauld had been alone at the Ice Cap station. The understanding was that he would be relieved on May 1, but we always thought that it might be possible to relieve him earlier than this. During February the weather seemed to get better, and I decided to send off a party consisting of Scott, Riley, and Lindsay to see if they could get to the station and relieve it early. This was a mistake, as the weather had not yet really improved enough for a journey on the Ice Cap.

They made two attempts to start, but were turned back, first by their sledges breaking, owing to being heavily loaded, on the hard wind drifts; secondly by not being able to find the Big Flag depot owing to continuous bad weather. Finally, on March 8, they left the base with light loads and reached the Big Flag depot in one day. Here they picked up their full loads and started towards the Ice Cap station. They had to cut their loads down to an absolute minimum, and so did not take a time-signal set for longitudes. We had found on all journeys that a compass traverse with a sledge wheel checked by latitude observations was extremely accurate for navigating on a course such as from the base to the Ice Cap station.

The weather on this journey was appalling, with blizzards every few days so that they could seldom travel. With these blizzards the temperature was much lower than usual, and this was certainly the coldest journey undertaken during the work of the expedition. They eventually arrived in the vicinity of the Ice Cap station with only a few days' dog food left. The wind drifts were so high that it was impossible to see far in any direction, and although they undertook an extremely careful search they were further hampered by a six-days' blizzard.

Scott was faced with two alternatives: he could stay and make a careful search for the station, which would mean he would run out of dog food and have to kill his dogs which were all required for future journeys, or he could go straight back to the base without losing a dog and still arrive at the base in time for another party to go up and reach Courtauld at the pre-arranged time, May 1. He chose the latter course, which was the correct one. They did an extremely quick journey back to the base in spite of the weather and arrived on April 17.

I immediately decided to go off with Rymill and Chapman to relieve Courtauld. In order to get there at the pre-arranged time I decided not to take food for another man to remain at the station, since the extra weight would delay us. We took dog and man food for five weeks, which would, if necessary, last us for seven weeks without losing a dog. We knew however that by now we need expect very few blizzards and no cold weather, and we saw no reason

to anticipate that the whole journey to and from the Ice Cap station should take more than three weeks. I realized that when the news got to Europe there might be attempts at "rescue" by air which might end in disaster for the rescuers and could certainly not be of any assistance to the expedition. I therefore left word with Lemon, who was in charge at the base, that he must do his best to stop all "rescue" attempts and let people in England know that I did not consider the situation in any way desperate.

We left the base on April 21, knowing that we could reach Courtauld within a day or so of the arranged time of relief. As we had anticipated, we had no difficulty. The weather was fine, there were no blizzards, and the temperatures were not low. On the last two days before reaching the vicinity of the station we had continual snowfall, so that we eventually camped on May 4, knowing that we were within about 5 miles of the station but not knowing in which direction it lay. Next day the weather was fine, and we took some observations, finding we were about 1 mile north-west of the station. We left our tents up and walked over to fetch Courtauld. Our first sight of the station was not encouraging; the only things showing above the snow were the Union Jack, the scientific instruments, a spade, and the ventilator of the house. We shouted, and up from the ventilator came a cheerful reply from Courtauld. We dug down, and in a few minutes out came Courtauld with an enormous beard. He had been alone for five months, and except for the last four weeks he had been able to do all the meteorological observations. Unfortunately we had built a wall round the house, and the space between this wall and the house had gradually filled with snow. Four weeks before we had reached him this snow had covered the entrance to the house. He had nothing to use as a spade in the house, so that he could not clear the passage. Of course he could have cut out through the side of the house, but he knew that in that case snow would blow into the house, so he decided to wait inside the house until May 1, when we were due to relieve him. When we reached him he still had plenty of food left (enough to last him two months on short ration), but his paraffin had almost run out, since two of his tins had leaked. This meant that for the last part of the time he had practically no light or fuel for cooking. In spite of all this he was most cheerful, and as soon as we had got him out he walked back to our camp. The whole undertaking had been a wonderful effort on his part. We reached him actually on May 5, four days late.

On May 6 we started back to the base. We could not ride on our sledges, as we still had heavy loads of dog food and man food which we did not want to leave, as it was required for future journeys. On our second day back we were surprised to see a large aeroplane flying over us. This dropped large quantities of food and a letter which informed us that it was a Swedish aeroplane piloted by Captain Ahrenberg. He had done a magnificent flight, leaving Sweden at the shortest notice, flying direct to Reykjavik, in Iceland, and thence to our base. He made an attempt to fly up to the Ice Cap station, but had to turn back owing to bad weather. He made another flight and could not find the station, but on his way back he suddenly saw our party on our way home with Courtauld, so he flew back to the base with the news. It was an extremely brave flight on his part, since the spring is the only time of the year when there is fog on the east coast of Greenland. On the day he arrived at our base fog came down along

the whole coast a quarter of an hour after he had landed, and it is extremely probable that if he had been a quarter of an hour later he and his two companions would have been killed. When we arrived back in England we learnt that the aeroplane had been chartered and Ahrenberg engaged by the Courtauld family, who feared that we might have difficulty in finding the station and hoped that Ahrenberg might find it from the air. We arrived back at the base on May 11, having averaged 25 miles per day on the return journey. The whole journey to and from the station had taken eighteen days.

Meanwhile there had been the attempt to reach Kangerdlugsuak by a journey up the edge of the Ice Cap; this had failed owing to the blizzards.

*Fourth Journey: Mount Forel*

After this there was a successful journey to the mountain region north of the base. In 1912 De Quervain, the Swiss explorer, had crossed the Greenland Ice Cap from Jakobshavn to Angmagssalik. On the crossing he saw a range of high mountains about 100 miles north of Angmagssalik, and named this range Switzerland. The highest mountain in the range he named Mount Forel. He measured it from a distance and found its height to be about 11,000 feet. If this height was correct, then it was the highest known mountain in the Arctic.

On May 6 Stephenson, Wager, and Bingham set out from the base to map the region between the base and Mount Forel and the district round the mountain itself. If it was possible they were to attempt to climb Mount Forel. This journey will be described fully in a later paper, and it is only necessary to describe the main results here.

They reached the Big Flag depot in one day, loaded their sledges, and started on the journey. By taking a long sweep they avoided all the bad crevassed country and reached the base of Mount Forel on May 26 at a height of 9400 feet after a journey of 176 miles. They spent a certain time in finding a suitable way up the mountain and then started on the climb. The first day they cut steps to prepare the lower part of the climb, and then after a day's halt, owing to unsuitable weather, they started on the main attempt. Unfortunately they were turned back about 700 feet below the top. They came on an ice slope below the summit. This was very steep, and it would probably have taken them two days to cut steps up it. They decided that it would be better to spend their time in surveying the surrounding country, so they returned, but not before they had done the highest climb that has ever been done in the Arctic. They spent the rest of the time in surveying the country round Mount Forel. This party reached the base on June 10.

(*To be continued.*)

*Note on the Maps.*—The general map illustrating this paper is based upon the Danish Government Map of Greenland, 1/2M, 1906, with local corrections and additions, but has no pretence to show in detail the coastal surveys of the expedition. The map of the Base neighbourhood is from the surveys of the expedition.

The second part of Mr. Watkins's paper will contain the map of Kangerdlugsuak, and that of the coastal journey southwards as far as Umivik.

The survey of Mount Forel will be published with Mr. Stephenson's paper (read April 11), together with the map of the coastal journey northwards so far as the results are available. The detailed mapping of the coastal mountains from air photographs must be undertaken later.—Ed. *G.J.*

# A FOURTH JOURNEY IN THE TIEN SHAN: *A paper read at the Evening Meeting of the Society on 22 February 1932, by*

LIEUT.-COL. REGINALD C. F. SCHOMBERG, D.S.O.

WE left Qara Shahr on 31 May 1931, and were glad to get away from the dirty fly-blown town, which is the rendezvous for the Torgut and Khoshut Kalmuks who regard it as little less wonderful than Paradise. After spending two nights at the headquarters of the Torgut chief at Khotun Simbel ("the Moslem encampment") we left the main Khaidik valley and followed the Kapchigai valley as far as the Kotil pass. Crossing this, our route led through the Yulduz, which we left by the Narat pass, and reached Aral Tepe in the upper Kunges on June 15. The weather throughout the Yulduz had been execrable, with unceasing rain, wind, and mist, and it pursued us into the Kunges across the watershed, for on June 16 a storm swept down, flooding the fine felt tents of the Qazaq headmen, and damaging the contents. The rain went through the thick coverings of the *auls* as though they were muslin. My object was to re-visit the upper Kash, and particularly the valleys north of the Satleh pass, and the Manass mountains, an area which the shortness of supplies and the lateness of the season had obliged us to leave in 1928. Accordingly we crossed the watershed between the Kunges and Kash valleys on June 19 by the Koktassin or Qaraghai Su pass (9560 feet), one of the many passes that connect the two valleys, and at this time of the year convenient enough, though rather steep. Later in the season the Kangrai Su pass, due east of the Koktassin, is one more convenient and frequented, besides being a good deal nearer. We reached the Umuraba Sai on June 21, a most gorgeous day, which we foolishly imagined was an augury of good weather. The upper Kash was wholly deserted as it was too early for the nomads and their flocks to move to the higher pastures; and we had, mercifully, the place to ourselves.

Although the next day was threatening, I moved a march up the valley, leaving the main camp to follow; but the weather broke and torrents of rain fell relentlessly for five days. I discovered, too, what I had not bargained for, that the river was unfordable, and that consequently we should not be able to reach our objective for at least four weeks, if not longer. In these circumstances it was no use havering and wasting time. The only course was to abandon our plans and all further attempts on the headwaters of the Kash, and explore some more favourable area. It was a great disappointment and a grievous waste of time to turn back, but it all proves how difficult travel is in the Tien Shan. It was true that in a month's time the rivers would subside and be generally fordable; but at the same time the grass in the upper valleys would be growing scanty, the danger of an early snowfall blocking the passes was not remote, and the general disadvantages of a waning season would be considerable.

The flocks in the remoter uplands only stay a week or ten days, as the herds fear being snowed up on the higher pastures. Short though the stay of these animals is, they finish up the grass to the detriment of the traveller. This was our lot in September 1928, where we found extensive pastures absolutely barren, and with no means of feeding our animals.

We descended the Kash valley, wading through the luxuriant pastures, shoulder-high in the lush greenery, and our ponies revelled in it. We met, on our way down, parties of Qazaqs moving up. Their plan was to go up the valley and eat their way down, thus spending the autumn days in a lower altitude. We reached Kuldja (Ili) on July 6, and let the animals have a week's rest. The flies were intolerable, and although our house was in the new quarter, away from the bazaar, it was well-nigh impossible to eat or to read. The town was full of a mongrel crowd, including many refugees from

*Sketch-map to illustrate Col. Schomberg's fourth journey in the Tien Shan*

the rule of the Bolshevists. Good black beer at fourpence a dozen bottles helped to enliven our stay, as well as the great hospitality of the Rev. Theodore Hufnagel, the Catholic missionary. His six-year-old white wine was a revelation, and so was the four-year-old red; both illustrating the great possibilities for viticulture in the Ili valley.

We left on July 13, crossed the Ili river immediately below the confluence of the Kash and Kunges rivers, and where that river properly begins. The ferry boat was large and commodious, and rushed across the stream, being the fastest form of transport in that region. The route now led through the

curious nondescript range that lies between the Ili and Tekes river. These hills are little known and are not inviting. The forest is poor, and the trees are being rapidly and ruthlessly destroyed as the wood is needed in Ili. As the perpetual snow is scanty, and as the forest fails to retain the melting snow of spring, there is a great shortage of water, but there are nevertheless considerable grazing grounds; and, especially on the northern side, villages of some size. The moisture on the south of the range is less, and the absence of trees and brushwood, partly natural, partly due to cutting, is very marked. All the same this range of mountains deserves study.

We reached the Tekes valley by the low grassy Saraghujin pass, and came to Kuba, on the Tekes river, where a Chinese amban had been recently installed, and where our pet sheep, Li Darin, joined us.

The appointment of this magistrate was most unwelcome to the nomads, who preferred the easy sway of the remote military governor to the constant presence in their midst of a Chinese officer. The amban lived in a merchant's house in the bazaar, and he was not having an easy time of it. He had been boycotted and driven out of the large Kalmuk lamaserai farther to the west, and after a sojourn at Kuldja he had been told to try his luck at Kuba. When we were there the betting was against the amban. The truth was that all the nomads, Qirghiz, Qazaq, and Kalmuk, were determined to get rid of him. They knew they were exchanging a King Log for a King Stork, and hated the idea. Naturally the military mandarin had no love for his civilian supplanter with the inevitable loss of prestige and perquisites. Administratively speaking, a civil administration would perhaps be an improvement, though the control of the nomads was in no case an easy matter, complicated also by the proximity of the frontier.

There is something very dreary in the Ili and Tekes valleys, with their mongrel population, their gangs of nomads, and the untidy, higgledy-piggledy villages and cultivation. The wide grassy plains are treeless, the crops, badly weeded, are inextricably mixed up with the tall grass, and the inhabitants—all immigrants—never regard themselves as permanent occupants of the land, but show, in their houses and their husbandry, their intention of some day moving elsewhere. Yet the land is kind, agricultural conditions good, and no reason exists for this reluctance to settle down permanently.

We were glad, then, to enter the mountains. We crossed the Tekes by a bridge, the private speculation of an energetic Kashgarlik, and entered the Kök Terek Sai ("green poplar valley"), one of the few places in Chinese territory, north of the Tien Shan, where Qirghiz are found. These belong to several branches, but the largest sept, of about three hundred families, is that of the Ming Murat, who came about a century ago from Qara Qol, now in Russian Turkistan. We reached Chongkurtur (9415 feet), an encampment on an old grassy moraine, on July 20, and as the track to the head of the valley was very awkward, we had to cross into the adjoining Cholaq Terek Sai by an easy pass from which a track led down a precipitous greasy slope to the bed of the valley. It was a wonderful sight to see the pack animals go tumbling head over heels down the hillside. The boxes flew off, and most of them burst asunder on meeting a rock, and their contents strewed the slopes. Clothes, maps, dry plates, medicines, Chinese paper money soon littered the ground,

and took long to collect as much got hidden in the creeping juniper. No animals were killed, and most of the scattered articles were found, but the delay was great, and heavy hail and rain hampered the search. The irreparable loss of fifty eggs nearly broke the cook's heart; and I shared his sorrow.

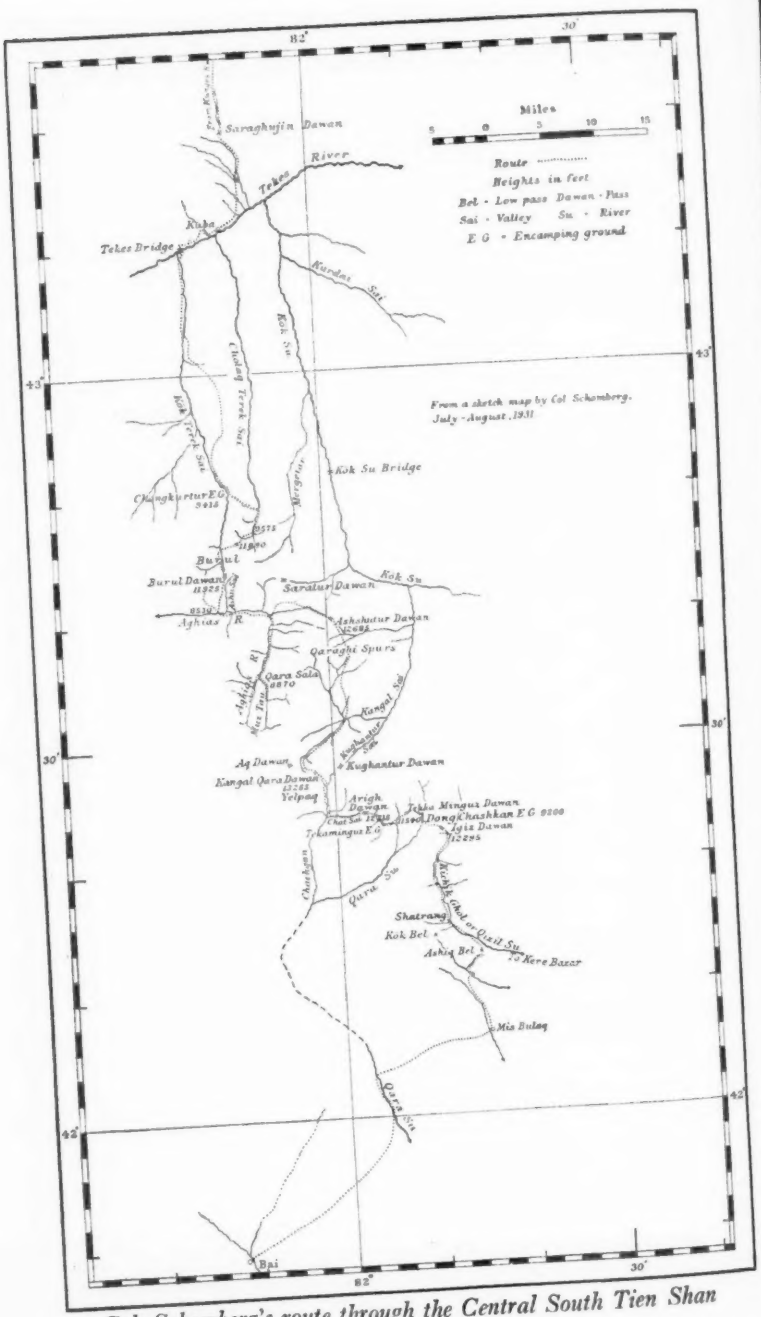
On July 23 the head of the Cholaq Terek Sai (9575 feet) was reached. This valley belongs to the Alban Qazaqs, and they say that the valley's name is derived from the destruction of the poplar trees for forage in the winter. "Chöl" is the Turki for desert, and this valley, once full of poplars, has now become denuded of them. The destruction of the conifers in the neighbouring Kök Terek Sai was truly melancholy. The whole valley carried dense forests of the dead trees which had perished, so the Qirghiz asserted, by forest fire. They said in particular that refugees had squatted in the forests during the time of the Russian revolution, had lit fires, and these had destroyed the trees. The objection to this theory (on which they were most positive) lies in many acres of forest being destroyed in an inaccessible place which even a refugee acrobat could not reach. Even helped by a strong wind, it is doubtful if fire could cause such widespread damage, and it is probable that some insect pest was concerned in the harm in certain cases.

In this valley, the Kök Terek, I saw the small black fly which deposits an oblong white secretion on the underside of the leaves of the spruce tree, and which was found at work. Captain George Sherriff, H.B.M.'s Consul-General at Kashgar, had heard of this and had drawn my attention to it. The Qirghiz shake off the deposit into a large pan, and melt it down over the fire. The result is known as *bāl* and used as sugar, but the nomads say that the secretion is not regular in appearance, that a warm summer is necessary, and that often four or five years pass without any being yielded.

After a very wet stay in the Cholaq Terek, a brief break in the weather enabled us to re-cross by an easy pass (11,890 feet) into the head of the Kök Terek. The descent on that side was very steep, and the mist was thick, but we groped and squelched our way down to the tents of the Qirghiz, and endured two more days' rain as best we could. We were now at Burul, a word expressing the green shoots of grass or shrubs that burst out in the spring, and the head-quarters of the Ming Murat Qirghiz and their chief. We said good-bye to our Qazaqs who had served us well but whom we neither liked nor trusted, for no one can feel confidence in any one who is a liar, a thief, and an underbred scrounger, and all Qazaqs, except the Kirei, are essentially that, brought up to steal, lie, and cadge from childhood. We met an old Qazaq here who had accompanied Merzbacher, and who yearned to chaperone us, but we realized that he was one too many for us, and escaped his clutches. He talked too much Russian to please us.

The Qirghiz admitted there was a route to the Aghias, but said that the track at the head of their valley was quite impossible. All nomads endeavour to prevent a traveller from following a new or different route, and probably their chief reason for so doing is laziness; they are afraid (and often correctly) that they may be forced to come too. There was only one course to take, to reconnoitre the Burul Pass: so, taking Daulat Shah and a Qirghiz, I set forth.

The appearance of the pass was disagreeable, for it looked like a steep wall of snow. The nearer we approached the steeper the ascent looked, but it also




*Col. Schomberg's route through the Central South Tien Shan*

looked shorter. After crossing a moraine, covered with dwarf yellow poppies, we started on the pass, and found it to be what the Qirghiz had described, a glacier covered with snow and with numerous crevasses. The total ascent up the pass proper was only 1000 yards, but it was very steep, and we sweated profusely. The crest of the pass was very narrow, and the descent on the southern side was free from snow, and easy over shale.

From the summit the view was superb, with all the unknown, unmapped giants of the heart of the Tien Shan rising before one. There were years of exploration, I realized, for future travellers amongst these gleaming peaks and hanging glaciers and black unentered valleys. These secret snows were enthralling. The height of the pass was 11,925 feet. We came to the conclusion that it could be crossed by our pack transport—coolies are unknown in Central Asia—and started on July 28, a fine morning. If it had rained or snowed the crossing would have been impossible. The kindly headman provided us with an excellent Qirghiz guide (a rarity), some spare horses, and two other men. Everything went well, if slowly, until we got within 200 yards of the top. We had to clear away the snow to enable the horses to get a foothold; and in doing so, to our disgust, exposed a number of crevasses, just large enough for a horse to get jammed in; and the first thing we saw was two of our best horses, King Mulberry and Kök Sultan (Greengage), wedged in a crevasse. It took three and a half hours to accomplish the last 200 yards to the top of the pass, and most exhausting work it was, carrying kit, hauling horses, digging out the donkeys—a heart-breaking, boring business. In the midst of all this labour, bad language, and perspiration, the Qirghiz guide produced a large skin of koumiss, which greatly comforted us, and we finally reached a grassy plot on the southern side of the pass. The Turki pony-men who spend their lives amid the miseries of the Ladakh–Karakoram road were quite demoralized and wished to halt, in a place without fuel or shelter, and where a sudden storm would have troubled us sorely.

We went on to the Aghias river. The distance seemed unending. Down and down we went, with the muddy waters of the river in sight, and after endless trouble over an abominable track we reached the right bank of the river, height 8530 feet, and got the tents up just as the rain came down. Opposite on the left bank the forests of spruce swept down to the glacial river, whose white waters give it the name of Aghias, and on the right side willow and other shrubs grew. The blue gentians were very abundant, from the diminutive little star gentian to the large bell-shaped ones, known to the Qirghiz and Qazaqs as the Kök Baichichike, whilst the large, short-stemmed white gentian was also abundant.

The pasture in the Upper Aghias was very fine, but it is preserved for the winter months when the Qazaqs, both Kizei and Alban who have definite grazing grounds, bring their flocks for three months' sojourn. The river is then fordable and the journey easy, whereas when we were in the Aghias it was impossible to descend the broad valley which unfolded itself in a vista of swelling forest-clad ridges and grassy slopes. We were comforted in finding abundant mushrooms, wild spinach, and rhubarb, for which we had previously searched in vain.

Beautiful as the head of the Kök Terek Sai had been, with its side valleys

crowned with snow peaks and hanging glaciers, the Aghias was even more so. Every small side-water had a glacier at its head, while the slopes of the left main valleys were clad with thick brushwood, willow, and spruce. The right of the valley was very steep and very barren, and a climb to the top, over the wiry grass, was no easy matter. We moved up the valley, and fortunately were able to ford the river early in the morning, and to camp just beneath where the Saratur ("grassy place") stream flows from the pass of that name, and below the water from the neighbouring Ashshutur pass.

The main Aghias valley now turned south, and at a place called Qara Sala, descriptive of the black projecting rocks at the head of the valley (height here 8870 feet), the two main sources of the Aghias river unite, after flowing from two adjacent glaciers. The eastern affluent seemed to me to carry more water than the western, though local opinion was against me; but at 11 a.m. the water was well up to the saddle, and it was only by clutching the pommel of the native saddle, and half kneeling on the seat, that it was possible to ford the stream. On such occasions the unshod weedy Qirghiz horses are better mounts than their Kashgarian brethren, as the latter always dislike being kept with their heads against the current, though that is the only way to cross these rivers.

There were other differences between these two tributaries. The left or western stream flows from its glaciers down a narrow gorge, which in several places is bridged by fallen rocks; and in places the breadth is only 4 feet, with the imprisoned river roaring below. Above the mountains rise cliff-like, and it is a weary climb to reach the source of the river. In this western arm of the Aghias there are two glaciers only, one from an ice-fall that descends steeply from a short arm running south-west; the second and the main source is a glacier which flows from the east, and then, embracing a subsidiary one, turns north. The whole upper valley is filled with this combined glacier which seems, like its colleague in the eastern branch, to be advancing very slowly again after receding. The eastern arm of the Aghias is broad, and the progress of its glaciers will be unimpeded. In the western arm however the glacier and moraine have reached the gorge, and in a few years, given the continued advance of the glacier, the state of affairs will be most interesting. This glacier gave the impression of having slipped from the right to the left of the valley, and was filling up completely the left side—the right was already choked with debris.

I walked a great deal over the combined glacier and its awkward moraine, and whilst crouching in the rain during the continual storms I had ample leisure to watch it. The noise of the stones and rubble shooting down the ice-slopes was constant. My Hunza men declared it was a good glacier, and compared it favourably with their Batura, which is much larger. In Merzbacher's map both glaciers, the eastern and western affluents, appear too long and are not quite rightly co-ordinated. The eastern glaciers are less easy to "work" owing to the river, and bad weather and shortness of time did not allow of proper examination of this affluent. Both these valleys are named Muz Tau, or ice mountain valley—a ridiculous but characteristic piece of nomenclature in a land where every valley might be so described.

Curiously enough we had several visitors, unwanted ones. When they

*Looking east from near the top of*

*Looking west from the*

*the top of the Ashshutur Pass*

*from the Igiz Pass*

*Horses in creva*

*es in crevasses ascending north side of the Burul Pass*

*The Kangal Sai*

*Looking south from the Burul Pass*

*Peak to the left of pass at head of the Kangal Sai*

*Head of the Kangal Sai*

found that a foreigner had crossed the Burul pass they came over too: now an easy route for unladen animals on a track improved by us. It was just like the nomads to wait for a stranger to show them the way over their own mountains.

Rain, which was due to an almost perpetual cloud-cap that collected at the head of the western tributary, shortness of food, and the fear of an early snowfall rather hustled us out of the Aghias, where I should have willingly stayed for another month, but our Qirghiz guide warned us that we might never get across the main watershed if we dallied too long. Retracing our steps from Qara Sala, we camped below the Ashshutur pass—this melodious name only means the crossing place—above the Saratur slopes. It may be mentioned that there is only one Saratur pass known to the Qirghiz, that shown on the accompanying map; and to reach the Mergetar valley, which flows into the Kök Su, it is necessary to return to the Kök Terek Sai and cross straight into the Mergetar, to which there is no direct route from the Aghias.

The Ashshutur Dawan (12,685 feet) was crossed on August 8, and it proved a very easy pass, and quite free from snow. The view to the south was good, but on ascending a promising ridge half a mile due west, and about 500 feet above the pass, we beheld a superb prospect. Below, at the head of a valley, was a large glacier with several small lakes from which a stream flowed through an insignificant nala into the Aghias above the Saratur stream. No one would have suspected this glacier. There is usually some catch about an easy pass in Turkistan, and so it was with the Ashshutur, as we found that two spurs known as the Qaraghi had to be crossed. The first was steep enough, and descended along a sort of grass-cliff into a good pasture. We managed this spur successfully, but were much perturbed to see a narrow perpendicular chimney confronting us, which was facetiously called the "road." In this we came to grief, many times, but finally reached the top, and looked down, dismayed and disgusted, on a series of precipitous slopes. The Ashshutur pass is on the Aghias–Kök Su watershed, and we now looked down on the Kangal valley, a tributary of the Kök Su. We wound along these cliff-like slopes, down into a ravine from which we climbed tediously, and finally descended steeply into the narrow wooded Kangal Sai (8035 feet), with great cliffs and snow-peaks above, and below spruce forests clinging precariously to the sheer sides.

It hailed furiously as we arrived in camp, and then it rained in sheets all night long, and in the morning I found Li Darin, the sheep, lying comfortably by my bed. A Tien Shan sheep is a good judge of weather. Here the horse-flies (Kokyin in Turki or Khamang in Chinese) were very trying; and so too was a fly like a bee, but not so respectable in its calling. Both were blood-suckers, and attacked man and beast alike. Even in the glaciers we were not free from them. They filled our tents, attacked the horses, and were a great pest. Common enough on the plains, it was difficult to understand how they managed to live in such high altitudes, where animal life was scarce.

The Kangal Sai formed a typical Tien Shan valley with a narrow bed and a rough stony track which brought us through fine scenery to the foot of the Kangal Sai Pass, which we had been told would be the *pièce de résistance* of the journey. Here all but one Qirghiz left us. The Qirghiz were pleasant fellows, and far nicer than the Qazaqs, but all these nomads are alike. Any job of work,

no matter how easy and well paid, is irksome, for a nomad's labours are limited to a few hours spent in rounding up horses. The men with us were well paid and well fed, and only one long day's march from their *auls*, but they could not endure the exertion of riding with us, and towing a pony, and preferred twiddling their thumbs in their tents.

We left our camp at the head of the Kangal Sai (height 9730 feet) on August 11 and started to cross the Kangal Qara Dawan, so called to distinguish it from many other Qara Dawans in the vicinity. As we left camp at 7.15 a.m. we congratulated ourselves on the beautiful weather. The valley turned east, and just at the turning a large disreputable glacier thrust down its snout. Climbing over the moraine, and then over the upper part of the glacier, we came to the mouth of a nala adjacent to the head of the valley which was a mass of snow and ice. Due west, and immediately opposite, was the Aq Dawan, or White Pass, so called from being always snow covered, and affording another example of the poverty of the local nomenclature. A difficult and rarely used track leads over this pass to the Qarabagh District, north-west of Bai. By a coincidence, just as we passed the mouth of this pass at 9 a.m. three Qirghiz women and two men came over it. They were probably as much astonished to see us as we were to see them.

We were now on the right of the main valley, at the mouth of the side nala, which was a mass of shifting shale. Our troubles began. There was no track, the gradient was steep, and the hillside was always slipping, and it was only by making five men walk in front, and lay out a sort of rough path, that we were able to move. This road-making had all to be done by hand, and it was chilly work, as the fair morning had changed to a mist-ridden sky with a little snow. I estimated the distance from the foot of the pass to be 1½ miles, and it took three and three-quarter hours to reach the top, height 13,255 feet, which is considerable for the Tien Shan. It was a slow, tedious climb, and I asked my men what they thought of the pass, as the opinion of experts from Hunza and Kashmir was more valuable than my own. They seemed surprised at the question, and said it was a really bad pass. Personally, I do not call the Kangal Qara Dawan very difficult, except after rain or melting snow, when the shale would be very precarious, and the many small landslips would be fatal to pack animals.

From the top we looked down on an affluent of the Qara Su and entered a very different country. A series of abrupt serrated ranges, powdered with snow but otherwise naked and repellent, lay before us, contrasting greatly with the narrow grassy slopes and tree-covered mountains behind us. Shooting over a few yards of snow-wall, we tumbled down a nala, a mass of shale and stone, passing a stream cascading through a narrow gorge; then we went over a very rough moraine from a glacier in the north-west, and finally reached a grassy patch (height 11,305 feet) with another nala coming down from the pass at the head of the Kughantur (dry or barren place) Sai, a branch of the Kangal Sai, but a little-used route as the glacier on the north has too many crevasses to be pleasant.

We were now at the head of an open, rather shallow valley called Yelpaq, with fair grass but no wood. There were some flocks of sheep with Turki shepherds, who gave us the latest news, a month old, from their metropolis,

the grubby town of Bai. But we were disappointed, as we found no supplies at all, although we had been told we should have some, and we badly needed flour. It is a feature of Turkistan that accurate information on the simplest point, well within the modest intellectual capacity of the average native, is quite unobtainable. The lack of fuel seriously inconvenienced us. A few "camel's tails" were to be had, but they were scarce, and horse dung hardly suited.

After Yelpaq the main stream, which is now called the Chachgan, flows through precipitous cliffs and hillsides of a great height, and the track turns east to avoid the defile which is passable in winter for unladen animals, with some difficulty, and after steps have been cut in the ice. It is only urgent need of supplies that makes this track used. Crossing a high spur we entered the Chat Sai (Chat in Qirghiz-Turki means the union of two rivers), and most unexpectedly came to a broad open grassy valley, about a mile in width, really an old moraine. It was curious to see deposits of stones brought down by torrents in spate, covering the grass. As often happens, this old moraine was very swampy. The ascent by the Aral or Arigh Pass (the word only means division), height 12,215 feet, was easy. This pass is the watershed between the two main branches of the Qara Su.

The view was impressive and sombre rather than beautiful and stimulating, for wherever one looked there was the same panorama of abrupt, jagged, well-nigh perpendicular mountain ranges, barren, harsh, and inhospitable, with patches of snow and small glaciers clinging uncertainly to the rock. Farther to the west rose a great massif of blackish stone, holding more snow. We did not like the scenery at all, as we wanted wood, and as the pony-men scanned this naked prospect cries of *wa dada-im*, *wa ana-im* ("alack, my father, alack, my mother") arose as their faces fell; for beyond a few sticks in a bag we had nothing wherewith to boil the pot, and to a Turki food comes first, before family, or money, even before life.

As a matter of fact we were not so badly off, but being without any guide we groped along without knowing it. Descending steeply we found, poked away on a little flat patch of grass at the junction of two torrents, a Qirghiz *aul*, and there we managed to get some wood and dung, and even (at a great cost) a little flour for the ravenous Turkis. The name of this haven of refuge was Tekka Minguz, or the Ibex Horns. After a very wet night and morning, for the rain pursued us relentlessly, we crossed the pass of the same name (11,540 feet), and from it had a view to the south-west over glaciers and snow-peaks, whilst due north we saw the sable peaks at the head of the main Qara Su, to which we descended to a grassy valley. Here, by the river-side, we found a deserted hovel, in which was a fiddle and a great prize, four pieces of wood. We took three pieces of wood and camped at Dong Chashkan ("Below the hill"), height 9200 feet, just below the Igiz or High Pass. We should have fared badly without the three pieces of wood, as we had taken all that the Qirghiz at Tekka Minguz could spare. The local supplies of cow dung were useless, as the heavy rain had spoiled them.

The scenery at this camp was really impressive as giant cliffs soared above us, forcing the Qara Su into a defile, and obliging us to climb out of the valley by a high pass. We were now sick to death of passes, as we had been

crossing one a day for some time, and the prospect of having only one more cheered us immensely, well though we could have dispensed with it.

On August 15 we started to climb the Igiz Dawan, or High Pass, a stupid name in a region of similar passes. It proved to be only moderately difficult, the height was 12,295 feet, and the view west over the snow-covered rocky peaks of the Qara Su was fine but limited. To the north was the head of the Qizil Su, with its black peaks and corries, with a glacier gleaming against a background of black rock, whilst south and east was the cultivation of Kere Bazar and the arid, dismal foothills of the Tien Shan. The sight of the far-away fields and tall poplars gladdened our Turkis, who had begun to wonder if the mountains would ever end.

We descended the Qizil Su steadily, and camped 4 miles down the river with a thick forest of spruce and willow covering the steep bank opposite, and with excellent black currants close at hand. The sun came out for the first time for four days, and brightened the beautiful glen. To celebrate the end of the mountain journey, the men made a *mazar* or shrine, piling up the stones, placing old sheep and ibex horns on them, and putting up sticks with bits of cloth as *ex voto* offerings. The materials for founding a centre of devotion are easily come by in Turkistan, and it was our pious hope that this shrine might become a place of pilgrimage in a district notoriously lacking in hagiographical interest. The men were all devout Moslems and much pleased with their shrine.

We continued to go down the forest-clad widening valley, and very charming was the scenery. At Shatrang there were wide pastures, rather eaten down at this time of the year; and a little lower we left the valley, which ended in the cultivation of Kere Bazar, and climbing the steep green side to the Ashiq Bel we descended into a maze of waterless valleys to the north of Mis Bulaq. There were a few spruce trees in the upper part of these valleys, but the general aspect of the country was very desolate and dry, for the aridities of Southern Turkistan affected the vegetation. Finally, after crossing another *bel*, or low pass, we entered the wide valley to the north of Mis Bulaq, and late in the evening of August 16 we reached the Sheikh's house, and the old gentleman tottered out to meet us. We camped near the delicious water of the spring (I could not discover why it was called Copper Spring) under conditions very different from those of the past month, which seemed dull and commonplace after the romantic scenery of the Tien Shan. Even at Mis Bulaq we could not escape the rain, but it was not so plentiful. The journey was certainly arduous and not really suitable for laden ponies, but the route was a new one, and enabled us to see unexpectedly large glaciers and forests on the southern or dry side of the Tien Shan.

## DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: I do not know why it is that some parts of the world are spoken of as very interesting countries. It is not their shape, for the Rub al' Khali is as interesting as the ice-caps of Greenland; not their people, for the hardly inhabited forests of Brazil are as interesting as a Chinese city. Whatever it is, we are to hear to-night of what

is in all respects, and from all aspects, a very interesting country: the Tien Shan, the Heavenly Mountain, which lies between Soviet Russia and China; and we are to hear of it from one of whom I may say that it is his pleasure-ground. When a man can give a lecture which he calls "A Fourth Journey," not only must he have a great knowledge of the place, but it must have been a great pleasure to him to go back to it. Colonel Schomberg was at Oxford and then in the Seaforth Highlanders. He served with distinction and then took the opportunity of carrying out various investigations in Asia on which he lectured to us at an afternoon meeting of the Society in 1930, on "The Climatic Conditions of the Tarim Basin," and at an evening meeting, on "Three Journeys in the Tien Shan." To-night he will give us, in a lecture which I now ask him to commence, his account of "A Fourth Journey in the Tien Shan."

*Colonel Schomberg then read the paper printed above, and a discussion followed.*

The PRESIDENT: We had hoped that Colonel Howard Bury would have been present this evening, but he has been obliged to go to the country. He writes to say he is sorry he cannot be here, for he has travelled much on the edges of the country that Colonel Schomberg has described. If he had been here he would like to have emphasized the extraordinary richness of the northern slopes of the Tien Shan in birds, animals, and plants, compared with the extreme poverty of the southern slopes. You heard our lecturer say there were with us to-night no less than three Consuls-General of Kashgar able to speak. I left the choice to them, and Mr. Skrine is the one who has been elected to address us.

Mr. C. P. SKRINE: Of the three Consuls-General who are present I am certainly the least qualified to speak. In the first place, I was in the part of the world about which we have heard longer ago than any of them, it being some seven years since I left Chinese Turkistan. In the second place, I have never been in the country to the north of the main axis of the Tien Shan, with which Colonel Schomberg's most delightful, amusing, and beautifully illustrated lecture was chiefly concerned. There are however one or two points I should like to make in connection with what he has told us.

The chief, in fact the only regularly used pass over the Central Tien Shan is the Muzart, which goes over from Aqsu to the Tekes Valley and Kuldja or Ili. Colonel Schomberg, I gather, travelled southwards from Kuldja through the Tekes and Yulduz valleys, and over another and even more difficult pass to the east of the Muzart, a pass which had never before been crossed by a European. This fact alone lends exceptional interest to his experiences. He came out on the south side of the mountains at a small town called Bai. My wife and I visited this place in 1923, when we marched eastwards along the southern slopes of the Central Tien Shan from Uch Turfan, visiting the Yangi Art and one or two other alpine valleys on the way. At Bai we turned south-westwards and returned to Kashgar *via* Aqsu and the Tarim River valley. The lecturer spoke, as does Colonel Howard Bury in his letter read by the President, of the fact that the southern slopes of the Tien Shan are generally regarded as extremely arid, with little vegetation and particularly few big trees. We saw only a few scattered conifers in Colonel Schomberg's pictures of the southern side of the watershed. I, on the other hand, was struck by the flourishing forests of conifers, which I took to be pines and *picea schrenkiana*, which I could see with the glasses away up in the alpine belt of the great massifs. This was to the west of the Muzart Pass, *i.e.* well to the west of the bit of country which the lecturer passed through coming down to Bai. I could only see the rim of the forest, as it were, along the tops of the ridges, for in those parts no conifers will grow on the southern side of the slopes where snow does not lie; but they stretched for 50 miles or more east and west,

and there was no doubt (and my local inquiries bore this out) that the forests in this part of the Tien Shan are of considerable extent. I refer to the southern versant of the great central massif of the Tien Shan, of which Khan Tengri, the highest peak of the whole chain, is the culminating point. Merzbacher, in his book, 'Central Tien Shan,' mentions this region, which he says is very arid, but he admits that he did not have time to go there.

I would like to bring this particular section of the country to the notice of future explorers—Colonel Schomberg himself, if he goes again, or any other traveller—as being one which would well repay close study. Apart from its forests and the probably plentiful flora and fauna therein, there is any amount of oil in that part of the world. I heard of several surface oil deposits, and the people use oil a great deal. I believe the oil deposits there are an extension of those in Russian territory in Semirechia, to the west. There are also surface deposits of coal. From a purely topographical point of view, again, the fact that the country is only partially explored—certain huge glaciers of which I saw the snouts far away in the north are, I believe, entirely unexplored—makes it of particular interest.

The plains at the southern foot of the Tien Shan are extraordinarily fertile. A local proverb says that you can get anything there except milk from a chicken. I saw one smallholder with his melon crop laid out on the ground in rows; there were, he said, between 15,000 and 16,000 of them. He was not at all proud of the crop, for which he expected to get about ¾*d.* per melon in the local market. In conclusion, I would like to say that I think the lecture one of the most interesting and amusing I have listened to for a very long time.

The PRESIDENT: I do not know whether Sir Francis Younghusband has been over the actual ground about which we have heard; I know he has been very close to it. You know, as I do, that when we are discussing matters of this kind, his word is one which we would always wish to hear.

Sir FRANCIS YOUNGHUSBAND: I should like to join with the Consul-General in congratulating the lecturer upon the interesting lecture which he has given us and on the very amusing way in which he has made us acquainted with the country.

The Tien Shan I visited first about forty-five years ago, when crossing the Gobi Desert; and then I well understood why it was called the Tien Shan, the Heavenly Mountain, because from the Gobi Desert you first see the Tien Shan as a line of white in the sky. You do not see the base of the mountains at all, but just the broad line of white on the horizon. I travelled for several days towards that line before I realized, as the base came into sight, that I was looking at mountains. That was a good deal farther east than the lecturer has described. Proceeding westward I saw these mountains towering above on my right-hand side, with the rivers coming down from them on to the plains and forming a succession of oases through which I travelled. But farther westward I did go up into the mountains which Mr. Skrine was telling us of, and travelled amongst the Qirghiz. My experience entirely corroborated what Colonel Schomberg has said as to their genial qualities and their liking to take ordinary travellers into their tents and make them thoroughly at home and one with the family. Also it seemed to me that the ladies amongst the Qirghiz, as amongst the others, did most of the work and management, so that they were a very hefty, capable lot. All the people in those parts look extremely healthy and strong, although they live on uncommonly little. Perhaps you may have seen in to-day's *Times* a letter with reference to the healthiness of the inhabitants of the little island of Tristan da Cunha in the Southern Atlantic. Apparently, they feed there on very little, and only eat one article of food at a meal, either milk or grain of some kind, or

potatoes. Perhaps it is also because their meals are so simple that the people in the Tien Shan are so healthy. At any rate, they are a strong, robust people.

I congratulate Colonel Schomberg upon his interesting lecture and thank him for his enterprise in going again and again into that interesting region.

The PRESIDENT: One or two points have been raised which I think Colonel Schomberg might like to reply to.

Colonel SCHOMBERG: Perhaps I may add three or four brief remarks in reply to the interesting speeches you have heard from Sir Francis Younghusband and Mr. Skrine. Mr. Skrine, among other things, spoke of the fruit, and my mouth just waters for the fruit we had at Uch Turfan. The nectarines are especially good, and I have been twice there to eat them. The second time there were none—it was absolutely heart-breaking.

What Mr. Skrine said about oil is perfectly true, but you know when travelling in Chinese country it is advisable not to go and see an oil well or mines, or even to inquire about such things. Some Germans went three or four years ago to look at some copper mines, but a good deal of the trouble they subsequently suffered was due to that perfectly natural scientific curiosity.

I rather hesitate to differ from Mr. Skrine because he is far more learned than I; but he talked of conifers in the plural. I am prepared to bet him a small sum, say, one penny, that in the Tien Shan there is only one sort of conifer, and that is the ordinary Karaghai or Tien Shan spruce. It is true that in other parts, far away to the north, you get the larch—but I am not going into botanical niceties now.

There is one other thing about travelling in that country. I am sorry to say that the tourist season is for the time being closed in Central Asia. Sir Aurel Stein and the Haardt Expedition have had much to put up with. I feel it is only right that the Society should know the way in which a distinguished man like Sir Aurel Stein was treated. This is no place for politics, but I contend that one of the most distinguished archaeologists now living should have been treated with common decency.

The PRESIDENT: That is exactly what I was going to say. It is disappointing to find that these places are at present closed to us. Many a true remark has been made by Colonel Schomberg, and the truest of all was that we do not discuss anything in the nature of politics in this Society. We can only hope that in the future there will come a time when we can go and find that there is still much unknown country which the adventurous explorer who is prepared to risk a good deal can open up.

There are many points to which I could refer. The questions asked have been more or less answered. If Colonel Schomberg had made any complaint we should not have thought it very genuine, for it is quite evident that he took a most intense delight, as great delight as we have taken in listening to him, in crossing that pass and going through that country. His lecture has shown how very observant he was in every particular. He has shown us the different types of natives and told us of very interesting names and their interpretations. That is one of the most delightful things, to hear these great rolling eastern names. I know no Arabic or Eastern language, and I always long to know what these fine-sounding names mean, and this Colonel Schomberg has told us in more than one instance.

A very enthusiastic fisherman sitting near me murmured into my ear a question as to whether there were fish in the rivers. I am glad to tell him that there are many, and when he returns from that important duty he is doing in keeping us alive in this country, I have no doubt he will go across and have a good day's fishing.

I was going to refer to Tristan da Cunha, but that Sir Francis Younghusband

has done, especially with regard to the islanders' good teeth. I have never been there myself, but I know a good deal of it, and I only wish I could say the same kind of thing as to their intellect; it is not of such a high quality as their teeth evidently are. However that is somewhat of a digression from the subject of the lecture. Both Sir Francis Younghusband and Mr. Skrine have spoken from actual knowledge of the great charm of the country about which we have heard. What I do is, on your behalf, to thank Colonel Schomberg for one of the most delightful evenings I have spent in this hall. We make no comparisons, but he can rest assured that we are never tired of seeing mountains, and even if we were we should be afraid to say so, especially in the presence of Sir Francis Younghusband and others. Will you therefore, Colonel Schomberg, accept from this audience and from the Society our most sincere and cordial thanks for the admirable work which you have done in the Tien Shan, and for the charming way in which you have recounted it to us.

# THE NEW PHOTOGRAPHIC SURVEY OF SWITZERLAND:

*A paper read at the Afternoon Meeting of the Society on 15 February 1932, by*

MICHAEL SPENDER

DURING the course of some months spent in Switzerland during 1931 to study the methods of photographic surveying, I was fortunate enough to see much of the work of the Schweizerische Landestopographie at a particularly interesting stage in the progress of the new surveys. To have seen the processes of plotting and reproduction in Berne, to have accompanied a photographic field-party in the high Alps, and to have spent a few days with a topographer in Zermatt were exceptional privileges made possible by the kindness of Colonel Schneider, Director of the Landestopographie. I also wish to place on record my thanks to Herr Dipl. Ing. Zölly and many other members of the Survey, who from time to time went to great trouble to explain everything.

At the afternoon meeting of the Society on 9 May 1927,* Major Mason, R.E., described a reconnaissance survey carried out in the Shaksgam region of the Himalayas with the Society's Photo-Theodolite. The work was treated as an experiment and much of the account is devoted to considerations of precision in the instrumental equipment and in the resulting map. Such doubts as may have existed at that time as to the accuracy or resources of this method of photographic survey have in the interval vanished. Discussion is now concerned rather with questions of technique and economics.

The Swiss Federal Survey has developed a procedure which might be called the orthodox procedure, at any rate in terrestrial photogrammetry. Switzerland is well suited to the method, the standard of accuracy demanded is very high, and the service has up to the present not been hampered by financial restrictions. The technique is consequently especially adapted to these conditions; the Swiss survey shows photogrammetry combined with the use of automatic plotting machines in the regular work of the precise and detailed mapping, sheet by sheet, of a large territory during the course of some years.

## *The Dufour Map*

The making of maps was not forced on the Swiss by the exigencies of war. While the rest of Europe was undergoing the political convulsions of the nineteenth century, Switzerland, like England, was isolated and in a favourable position to develop its own economic structure. The first proposal to map the whole country came actually from a scientific society, who complained that geologists, botanists, and others had no more than a very inadequate set of maps as background to their field-work. In 1828 the Schweizerische Naturforschende Gesellschaft opened a special fund and considered how best to set about the task. The problem was of course rather overwhelming and much greater than was at first realized by the members of the Society. Fortunately a special Government commission under military authority was formed in 1832 to take the matter in hand. A further fortunate circumstance was that in the same year General Dufour was appointed Director of the survey. Dufour had formerly served with the French geographical engineers and was especially

*Mason (1927).

suited to make the best use of the experience gained both in the preparation of the French *Carte de Cassini* (1744–1815) and in the mapping carried out during Napoleon's campaigns abroad.

The first few years of Dufour's survey were spent in struggling with the difficulties of triangulation. There were a few existing surveys but they did not agree one with another; at the frontiers there were a few points from foreign triangulations; but the greater part of the work had to be done under considerable difficulties at a time when instrumental construction was not well adapted to field-work, when the art of climbing was quite undeveloped, and when money was so short that the engineer had to rely on his enthusiasm to see him through with the work. A trigonometrical framework made under such conditions, by different people at different times and from various bases, was necessarily imperfect. A further error originated in the datum for all the levels, which was the Pierre du Niton in Geneva; later determinations found this to be 3·26 m. lower than was supposed when the French gave it as the datum for the Swiss survey.

The topographical sheets were to be made on the scale of 1 : 50,000 with contours at 30-m. interval in the Alps, and 1 : 25,000 with 10-m. contours in the plain. The plane-table was used in both cases; in the mountains a graphic triangulation was carried out, and on the plain the subtense bar was used. The Naturforschende Gesellschaft assisted the authorities materially by subscribing towards the topographical work. The engineers, according to the traditional stories, made their wills before going into the mountains; once there, much of their energy was spent in persuading the assistants not to desert. In considering the later publication of the field-sheets, these facts must be borne in mind, together with the fact that the topographer knew that his work was to be reproduced at a half or a quarter scale, and that his contours were only to give the directions for the hachures.

The Dufour map was not completed until 1864. The Royal Geographical Society received a set of the maps in 1871. It is the map that is still obtainable by those who want a general map on the scale of 1 : 100,000. Originally pulled from an engraved copper plate, it is now printed from two stones—black and blue. For a long time after its first publication it exceeded any contemporary map both in the clearness of its presentation of mountain forms, in its fullness of content, in beauty, and in general balance.

### *The Siegfried Map*

Shortly after the completion of the map there was a demand that the field-sheets should be published on their original scale. It is interesting to note that the then young Swiss Alpine Club led the way by publishing a few of the sheets at 1 : 50,000. In 1868, at the initiative of Dufour's successor, Siegfried, it was decided to issue the entire series of field-sheets in their original scale. At the same time the revision of the sheets was begun. The revision has continued in various forms until the present day; during this period the topographers have developed and modified their own style of work; the mountains have become better known and more accessible as climbing has become a popular sport; and in 1890 a start was made with a new instrumental triangulation.

The consequences of working the new material into the old fabric were not always happy. The sheets varied greatly in quality from one to another, and even single sheets might contain surveys of widely different degrees of accuracy based on independent and contradictory trigonometrical frameworks. Moreover the work was tiresome and tedious; since the original fixed points were not to be found again the topographer could not make the whole sheet anew; to get the work completed at all he had to be very tolerant towards inaccuracy.

These revised sheets form the present-day Siegfried map, which is that bought by the visitor to Switzerland when he requires a map on the scale of 1 : 50,000 for climbing or walking. In spite of its flaws it has probably been one of the most successful maps ever published. One of the reasons for this is that the representation of rock and scree, of snow and glacier, and of mountain features in general has been developed to a degree of perfection which has made the Swiss maps famous.

It had already been realized before the War that for various purposes and in certain districts the existing maps were not of that high standard that the Swiss felt necessary.* That the official survey should have turned its attention at this time to photogrammetry was not in any way an accident. On various occasions experiments had been made to use photography in survey. As early as 1892 experiments were made which produced results as good as plane-tabling, though nevertheless at the cost of considerable time and trouble. Until 1896 the methods of "plane-table photogrammetry" were developed and improved, and from 1903 onwards they were included in the curriculum for surveying engineers at the Technische Hochschule in Zürich. In 1915 Dr. Helbling, who had a private laboratory in Flums, placed a Zeiss Photo-Theodolite and Comparator at the disposal of the military authorities for the mapping of the fortified areas. The experiments were wholly successful, particularly in the speed with which the maps were produced. In 1919 Dr. Helbling started work with the v. Orel-Zeiss Stereoautograph which led to co-operation with the Landestopographie in 1921. The experiments were again successful, and in 1923 the Landestopographie purchased for their own use the Stereoautograph from Dr. Helbling.

The Landestopographie was in fact in very close touch with the development and the possibilities of photogrammetry, particularly in connection with automatic plotting machines. During the years 1920–1922 several experimental surveys were made, and these were continued by the department's own staff between 1924 and 1927. In 1924 lectures on stereo-photogrammetry were begun by Professor Baeschlin at the Technische Hochschule in Zürich.

Contemporary with this work a remarkable brain had been attacking the problem from the instrumental point of view. Since his experience with the Swiss triangulation Heinrich Wild had been working with the Zeiss firm in Jena as a specialist in the design of surveying instruments. His knowledge as a practical surveyor of the field conditions in Switzerland was no doubt of great advantage to him. In his plotting machine he incorporated an ingenious

*See Schneider (1930), p. 133, "The available maps of the Alps must for technical and economic reasons be replaced by new surveys if the maps are adequately to fulfil modern requirements."

solution of one of the principal problems of design that allowed his Autograph,* as it was named, to be of comparatively light construction and easy to handle. For the field equipment he combined the light-weight "Universal" theodolite of his own invention with a camera capable of being tilted downwards in such a way that the combination was at once lighter, more accurate in use, and of greater capabilities than any other existing phototheodolite.† The Autograph, which was available for practical tests in 1923–4, had the advantage that it could plot from tilted and convergent photographs; it also had latent possibilities of being developed in a way which would permit plotting from air photographs.

Experiments on the one hand and the development of instruments and technique on the other, led to the conclusion that for the present conditions in Switzerland photogrammetry is an indispensable procedure in *topographical* survey. The Wild equipment was eventually chosen as standard for the new survey. At first two Autographs and four field equipments were bought, to which a third Autograph and two more phototheodolites were added later.

*The Task of the New Survey*

There are two survey organizations in Switzerland. The Federal Survey proper is part of the country's military organization, though the staff are civilians. This department is responsible for topographical survey but not for cadastral survey, which is the work of a division of a civil department (Eidg. Justiz- und Polizeidepartement). This latter, the so-called "Grundbuchvermessung," prepares the familiar large-scale plans of legal, economic, and scientific importance. The department also makes the IVth order triangulation (approx. 1 point per 0·7 sq. km.) and prepares an "Uebersichtsplan" that is really a topographical map of the districts surveyed. This map is on the scale of 1 : 5000 or 1 : 10,000 as the case may be with contours at 10-m. intervals and sometimes extra curves at 5-m. intervals. When this map is handed to the Landestopographie no further topographic survey is necessary.

Under the present programme the cadastral survey will be completed (on suitable scales between 1 : 250 and 1 : 10,000) during the course of fifty years from 1926. But the new topographical survey of the whole country on the scale of 1 : 50,000 has to be ready at the latest in 1948. The plain, the Jura, and the Sotto Ceneri Tessin will probably be completely mapped by the Cadastral Survey in 1946. "Uebersichtspläne" will therefore not be available for the Alps, which include about half the area of the country. The Alps will therefore be mapped by the engineers of the Landestopographie; they will mainly employ terrestrial photogrammetry and the work will be plotted on the scale of 1 : 25,000.

*The Terrestrial Survey of the Alps: Obtaining the Photographs*

Photographic survey from the ground, as opposed to that from the air, is practicable for a regular survey where the mountains are large and steep, and where, in fact, the view from the photographic station is one directed largely downwards and not unlike that which might have been secured from an

*See Hinks (1927).
†See Hutchison and Hinks (1926).

aeroplane. Further necessary conditions are that it should be possible to move fairly freely about the mountains to lay out the bases and that sufficient geodetic points should be in sight to fix the position of the station. A number of control points whose positions have been trigonometrically fixed and which may be chalet gables, stone cairns, etc., in the landscape are required to serve as a control during the plotting from the photographs.

Switzerland is admirably suitable for the method. The one outstanding difficulty that interferes with the work is pine forest; this not only hinders the choice of base-lines, but is so opaque that contours cannot be drawn through it. In the case of deciduous forests enough ground can be seen in air photographs to enable contouring to be carried through the trees; should this not be the case in summer, photography can be carried out in the late spring, before the snow is completely melted. But pine forest is intractable to any method of photographic survey and consequently has to be surveyed by the plane-table.

In the high Alps much of the country is above the tree-line: here the photogrammeter can move where he pleases. With the IVth order triangulation (supplied for the Cadastral Surveyor) he is rarely placed so that he cannot see sufficient points to fix his position; to his group of helpers climbing difficulties hardly exist; finally there are so many huts and stables that he seldom lacks control points.

The period during which photographic work may be carried out by any survey method in the high Alps is very short. Not until the beginning of July is the snow sufficiently melted, and by October, should the snow not have returned, the sun is so low that even at midday deep shadows strike across the landscape. But the triangulation, if not already made in a previous year, may be carried out before photography begins. The fixing of the points and the beaconing is done by the surveyor's assistants alone; the surveyor only needs to make a preliminary reconnaissance to lay out a rough scheme. The trigonometrical party is at an advantage in not being so dependent on the weather as the party for photogrammetry. If the weather is too bad for the higher stations there is generally something to be done in the valley. Experience has shown that the so-called topographic points which are later used as controls in the plotting (conspicuous natural features, chalet gables, etc.) are better fixed by the advance trigonometrical party than left to be included in the photogrammeter's scheme of work.

It should be noted in passing that the assistants play a most important part in the Swiss survey, both in triangulation and in photogrammetry. They have no technical training, yet have no difficulty in understanding the procedure they are required to carry out. They come from the same stock of men as the mountain guides; four men and an engineer will form a little party that will stick together year after year. Engineer and assistants share the same pot of Maggi soup and undergo the same discomforts of accommodation in the heights. They are the most cheerful company.

The photogrammeter in his reconnaissance searches not for single points with a good view, but for bases. A single photogrammetric station consists of two photographic positions. The line joining them is the base-line. The length of the line is between one-tenth and one-twentieth of the maximum distance at which it is proposed to plot, but cannot exceed one-quarter of the

minimum distance. The base must further be so directed that the normal to it is in the direction in which it is proposed to make the principal photograph. The two end-stations should be intervisible and at approximately the same height. Finally it must be possible to fix one of the end-stations by making a round of angles to triangulation beacons. During the reconnaissances the photogrammeter pays attention to principal stations rather than detail stations. A principal station will probably have a base some 500 m. long. If plotting from such a base were to be carried beyond 5 km. it would be good practice to use the camera with the long focus lens (F=237 mm.). A valley such as the Rhône valley can be almost completely surveyed from principal stations alone; but in other cases side-valleys and dead ground in the foreground will necessitate a number of detail stations. Even at the cost of much time and trouble it has proved more economical to make detail stations than to leave the gaps to be filled in later with the plane-table. But when the area of map plotted per pair of plates is less than a certain figure at present not ascertained, it would be more economical to use aerial photogrammetry.

Although it is necessary to climb to a high commanding position, the bases will only in rare cases be close to the higher beaconed points. Nevertheless upward-tilted photographs must be avoided, since they are the cause of many gaps in the plotting, although an extremely steep rock face such as the north wall of the Matterhorn affords of course an exception. A fact to be borne in mind is that though the triangulation engineer is likely to meet difficulties in actual climbing, the photogrammeter can generally arrange his work so that the going shall be consistently easy. Good arrangement of the field programme is necessary to make best use of the short season. The wise photogrammeter never climbs the same mountain twice, and by judiciously leaving the apparatus (duly protected) on the mountain-side he can save his party much unnecessary labour. Further, through accurate field-work and observation he can avoid annoyance and waste of his own time in the office later.

A typical day's work in the high Alps may serve as an example. We start off in a party in the silent hour before dawn. The night in the high mountains is cold and luminous. In addition to the clothes, rope, ice-axe, goggles, food, and all the normal clutter of the climber, our assistants carry the phototheodolite, the camera, two heavy stands, the plate-holders, a sunshade, binoculars, writing material, etc. The party reckons on climbing 600 m. in the hour. After we have climbed some way over frozen moraine, a rose tinge on the peak of the massif near us broadens and deepens to a band of yellow light on the snow-cap. The quick sunrise is an excuse to break the silence and call a halt. In the intense cold one does not care to remove the rucksack from the damp patch at the small of one's back.

After three hours of climbing the party, satisfied to stand 3500 m. above sea-level at 8 o'clock of the morning, holds a short discussion about the base. One of the assistants, always the same one, takes one of the stands, a target mark, and a 2-m. rule. As he traverses his way towards the next arête guesses are made as to its probable distance. It is so cold that it is necessary to invent some such pastime. Presently he halts and unfolds the 2-m. rule; we observe through binoculars with a pro-mil graticule in the eyepiece, compare readings, and reckon the distance. The choice of the best position, particularly if the point

*Photothcodolite station*

*Photothcodolite party on the move*

*By permission of the Director, Swiss Federal Surveys*

*Contour plate plotted on the Autograph worked up in pencil by topographer in the field to improve the representation of rock faces*

we had reckoned on turns out to be at an unsuitable distance, depends a great deal on the assistant, who must know what should be photographed and note which trigonometrical points are visible. Eventually, using if necessary his hammer and cold chisel to prepare a foothold for the tripod, he sets up the stand and target.

While waiting for the sun to climb high enough for photography, the round of angles is made and it is decided what photographs should be taken. It is of no importance which one of the two stations shall be trigonometrically resected. One of the assistants, always the same one, books the angles, while another attends to the sunshade. "Normal" photographs are in the direction at right-angles to the base. By swinging the camera 35$^g$ left and right of this position the "swung" (Verschwenkt) positions are obtained. If a further swing is required, a photograph 50$^g$ from the normal may be exposed. In the swung photographs the base is effectively shorter, since not the whole length but only the projection on the normal to the camera axis controls the magnitude of parallax; this must be borne in mind on the field.

The downward tilt of the camera (Kippung) causes no complications. The phototheodolite owned by the Society can be tilted in steps of 6$^g$ as far as 18$^g$ downwards. The newer models allow a fourth position of 24$^g$ downwards; it is surprising how frequently this position is used in mountain survey.

The photographs are taken on plates of plate-glass, 10×15 cm., coated with the special Topo-emulsion by the firm of Perutz in München. The camera has a lens of fixed aperture of *f*12 to which a 4-times filter is attached. The plates are very slow and permit all exposures to be made with a lens cap, though many might prefer to work with a simple shutter.

It is important to have a routine for the entire procedure in the field, otherwise when engineer and assistants are cold and anxious to get down quickly some small slip may be made in the setting of the swing or the observation of the levels or in another of the important adjustments. Later, when the photographs are set in the Autograph, it is a source of great pleasure if everything agrees after the values of base, swing, dips, etc., have been set in the instrument. A trifling mistake does not make the work valueless, but it is worrying and takes much more time to trace in the office than it would have taken to attend to the matter properly in the field.

To descend during the forenoon to work a detail station nearby is pleasant. The sun is warm, we are sheltered from the wind, and we see to it that there is time to cook tea; the party always carries a little wood to this end.

At a detail station the procedure is the same and the observations must be made as accurately as from a principal station. It is hoped, that is to say, to be able to take horizontal angles on to five signals as well as the remote camera station; vertical angles are taken where possible on to three signals as well as the other camera station. Even in the case of a detail station the length of the base is only very rarely determined with the subtense bar. The theodolite of the field equipment is such a precise instrument that a determination accurate to a cm. or two is obtained from the observation of the subtended angle at a suitably placed triangulation point.

The day is long enough to allow us to go down to and cross the glacier, to climb to a station on the other side, and to make the observations and

photographs from a base that can only be worked by the light of the afternoon sun. When the work is finished we leave the apparatus to rest on the mountain-side, pegged under waterproof coverings, while we return to our hut and our soup.

*Plotting from the Photographs*

The theoretical principles of plotting from stereoscopic pairs have already been described in the *Journal*.* It is a pleasure during plotting to be able to roam once again in company with the wandering mark that hangs in the field of the stereoplotter over the mountains that one learnt to know during the field-work. Broadly speaking, a given period of field-work occupies a corresponding period of work at the Autograph; that is to say, under Swiss conditions two field parties during a summer season of four months will provide work for an Autograph during the winter of eight months.

Although it is possible to plot a great deal single-handed, it has been found more profitable to have some one at the drawing-table for the greater part of the time of plotting. In Switzerland the photogrammeter who has worked in the district and the topographer who will later complete the map of the same district work together. The topographer has the photographs in front of him. He becomes familiar with the area and with the work that remains to be done to fill gaps; at the same time he satisfies himself of the accuracy of the plotting and arranges, for his own use in the field afterwards, the plotting of certain special points and features.

The necessary preparations for plotting are of course the arrangement of the plates and prints, the computation of the required data for each base, and the plotting of everything required, *i.e.* triangulation and control points, photostations and the coordinate grid, on to the glass-plate on which plotting is to be carried out. The glass-plate is covered with an opaque gelatinous film and drawing is done by means of a sharp steel scriber. Advantages of the method are, that remarks may be written in ink on the gelatine, that mistakes in plotting can be easily corrected, and that dirty hands do no damage. Furthermore the line drawn is so fine that an error of 0·2 mm. appears quite large; the Swiss surveyors require that the errors of plotting shall be within this limit. A disadvantage of the glass-plate is that it is fragile. Nevertheless, although other persons have had accidents, the Landestopographie has up to the present had none. Through the experience of those accidents that have happened to other people the Landestopographie have developed a marvellous technique of printing from a shattered glass-plate.

The procedure of plotting at the Autograph depends on the amount of available control. In Switzerland the conditions are such that work may be begun at almost any principal station. If everything is in order a perfect parallax-free stereoscopic model can be seen over the whole range of the negatives as soon as the plates are laid in the Autograph and the values of base-length, swing, etc., set on the respective adjustments. There will almost certainly be a triangulation or a control point or a few of each to be seen. With the aid of one of them the plate can be oriented; in general the positions and heights of all available control points agree accurately as soon as this has been

*Hinks and MacLeod (1922); Mason and Hinks (1927).

done. At the most, a trifling adjustment of convergence or of dip of the camera axes may be necessary. The readings of the final setting are recorded on a special form, and plotting may begin.

The general question of control in terrestrial photogrammetry is not the same as the question of control in Switzerland. The matter has been given special treatment in an Appendix, because from time to time it has been misunderstood.

*The Work of the Topographer*

The map that is obtained from the Autograph has not only contours but all the detail that it is possible to extract from photographs such as streams, roads, paths, outlines of woods, limits of snow, houses, etc. There are however gaps, some of which are due to the fact that it is impossible to photograph as much as 100 per cent. of the landscape, and some of which represent terrain covered by pine woods; further, roads and paths are neither complete nor classified, nor are there any names whatever. The map therefore must go into the field again.

The topographer is a very expert plane-tabler, familiar with the Swiss tradition and accustomed to work on the scale of 1 : 50,000. He takes with him blue copies of the stereo-photogrammetric plot at 1 : 25,000 and 1 : 50,000, a plane-table equipment, and one assistant. The greater part, the bread and butter, so to speak, of his work, is that which has already been indicated; but the part that is probably the most difficult, and from the point of view of many map users the most significant, is the so-called "Fels-Zeichnen." There is a general agreement amongst cartographers at present that contours alone do not provide a sufficient description of the scenery, even to a practised map-reader. There is required in addition something that is really an artistic use of light and shade in order to express that aspect of the form of scenery that is not fully conveyed by the most perfect contours. The comparatively crude differentiation between rock and scree, between snowfield and glacier, can be conveyed by a convention without departing from the ideal of a vertical projection of a vertically illuminated model: even where a glacier falls over a hang, the wildly crevassed band of ice can be conventionally represented.

But a rock mountain is very much more difficult to represent. The type of rock, the degree of weathering, and the way the strata lie combine to give a mountain an individuality. There is indeed in the structure and shape of a mountain that which cannot be grasped by contours alone: it is more than a problem of map-reading. Perhaps it does not belong strictly to the province of the map-maker to attempt to seize an elusive character which cannot be directly measured or recorded. But the map that conveys something of it will be all the more valuable. Dufour, at an early stage of the Swiss work, said that the topographic surveys should form the *basis* of the new map, as though to imply deliberately that to prepare a map was a great deal more than to draw accurate contours. In point of fact the Swiss have above all other cartographers been successful in the endeavour to give a living picture of mountain scenery.

It may be asked why this cannot all be done from the stereoscopic model in the Autograph. The difficulty is that in the photograph the mountain is seen from one point of view and under particular conditions of lighting. This is

sufficient to extract the superficial contours mechanically. But, as every mountaineer knows, the structural character of a mountain can only be learnt by a longer acquaintance under various conditions of lighting and from various points of view.

The topographer therefore ambles about his district classifying paths, checking the dialect nomenclature, filling in the blank spaces, making conventional representations of groups of dwellings, checking the already existing work, deciding which runnels shall be counted as streams, and much more; but always during the course of this work he is learning to know and sketching in the structure of the mountains. In the office he draws the whole map in ink over the blue copy, so that every line on the map has had his attention. When the blue is dissolved away there is left the topographer's finished sheet, which is probably the most beautiful stage in the preparation of a map. That which comes afterwards, the mechanical redrawing, the addition of names, etc., is all to the topographer a matter of regret.

This co-operation of the surveyor of the former era with the photogrammeter of to-day is interesting. At the first, the topographers were opposed to photogrammetry. Certain rash claims were made at that time which were quite properly opposed by a body of surveyors who from their experience knew that, for instance, by no technical method whatever could it be possible to survey mountains from the valleys. In addition to this was of course the fear of extinction. But in practice the machine does the mechanical part of the topographer's work, leaving him that which on the whole is very much more interesting than contour drawing.

An approximate area worked by a photogrammetric party in a single summer is 200 sq. km. Under the conditions here described the topographer works at such a speed that two, or even three, topographers will be fully occupied in order to cover in one summer season the field work of the photogrammeter of the previous summer. This is clearly another point in which the Swiss procedure is more dependent on the available means and on the degree of perfection required in the final sheet, than on the fundamental demands of the technique of terrestrial photogrammetry.

*Air-Survey in Topography*

Although procedure in terrestrial photogrammetry in Switzerland has been developed so far as to be no longer experimental either in its technical methods or in the economics of its application, the best use of aerial methods in topographical survey is still to a considerable degree unsettled. The Federal Survey has certainly used some vertical photographs for the provisional correction of the maps of the Swiss plain. But there is no plotting in the strict sense from these photographs and their use can hardly be included in the term "survey." In the survey of the Alps with which we are at the moment concerned, aerial photography has only been used in those exceptional cases where very little could have been done from the ground.

The use of aerial photographs in the mapping of wooded areas has already been mentioned; recent work near the Italian frontier, where there is forest but not pine forest, has produced maps without any blank spaces in a district in which terrestrial photogrammetry would have been hardly possible. The

narrow, deep gorge of the Dalabach below Leukerbad has been successfully mapped from the air. Another typical occasion was in the mapping of the Jungfrau district of the Bernese Oberland. No terrestrial station commands the snowfields flanking the Finsteraarhorn, so oblique photographs were taken from an aeroplane; the interval between two successive photographs was the base-line. Such photo-pairs are however somewhat troublesome to prepare for plotting.

In flying among the high Alps there are special difficulties and dangers that have caused the Landestopographie to be somewhat reluctant to employ aerial methods to any great extent. The Cadastral Survey, whose work is in the Voralpen and on the plain, is on the other hand very differently situated and uses air-survey a great deal.

*Cadastral Survey by means of Aerial Photogrammetry*

A full account of the work of the Grundbuchvermessung would be too detailed to be attempted here: there is an excellent description in the *Schweiz. Zeit. für Vermessungswesen*, March/April 1931, which was prepared by the Director, Herr Baltensperger, and his scientific adjutant, Herr Härry; to this account I am much indebted.

The early experiments with terrestrial stereo-photogrammetry had been plotted on open scales such as 1 : 5000, 1 : 10,000, which were in any case scales suitable for property surveys in the mountainous cantons, where the ground is not very valuable. A certain amount of cadastral survey was therefore carried out at first by terrestrial methods. But as early as 1925 a very successful series of experiments was made with aerial survey. Consequently, between the years 1927 and 1930, 750 sq. km. were plotted from air photographs as compared with 520 sq. km. from terrestrial photographs. The present tendency is to use air survey almost exclusively. The technique is more or less standardized and the costs fully worked out.

It should be mentioned before considering the technique of this survey that its organization is somewhat original. There is no official body of field surveyors. Although the photographs are taken from an aeroplane belonging to the Government, the plotting and preparation of the maps is carried out by private firms (of which there are at present four in Switzerland) owning stereo-plotting machinery (which is in three cases the Wild Autograph and in the fourth the Zeiss Stereoplanigraph (Model C/2)). Thus the central office has no problems such as the necessity of continuing to use obsolescent apparatus; in developing new technique the risks are taken by the private firms, who compete in their own interests in the working out of the most economic technique. This has led, as already said, to the almost exclusive use of air-photogrammetry. In cadastral survey very great precision is required; the accuracy obtainable from stereo-plotting machinery, sometimes criticized even in the case of air-survey as being too accurate for topographical scales, can in no wise be said to be exaggerated when applied to cadastral work. Air survey has shown itself moreover to be cheaper than other methods. The reasons for this are briefly as follows. Firstly, the area that can be plotted from a single pair of air photographs is on the average 1·0 to 1·5 sq. km., as compared with 0·3 to 0·4 sq. km. in the case of terrestrial photogrammetry after all the

detail stations have been taken into consideration. Secondly, it is easier to recognize and map from the air the property boundaries, etc., that are required in cadastral survey. Thirdly, the fact that the plotting is almost free from blank spaces reduces the amount of work that the topographer must afterwards fill in with the plane-table—work that is relatively very expensive, especially where, as in the Alps, the going is tiresome. Another reason is that in air-survey the accuracy of plotting can be accepted as uniform over the entire area plotted from a single pair of photographs. Finally, a short period of fine weather can be seized to make a great number of photographs; it is not necessary to support a party who may, as was the case during the summer of 1931, have to be kept in full commission for four or five weeks during which they can perhaps work no more than the same number of bases.

There are of course disadvantages in the use of air-pairs, of which the principal is the time that must be spent in the setting and orientation of the photographs. On account of shadows steep northern slopes are more difficult to map from the air than from the ground, and the coarser grain of the emulsion which must be used for instantaneous exposures prevents any air photograph from being as perfect to plot from as a good terrestrial plate.

*Procedure in Cadastral Survey from the Air*

The marking of property boundaries with boundary stones proceeds as in any other survey; in this case however the points are related by measurement to nearby objects such as the corner of a chalet or an isolated tree that will be recognizable in a photograph taken 2000–2500 m. above the ground. When this is impossible, the point must be specially beaconed; the signal is a sheet of aluminium, 80 cm. square. The photography is carried out at the first opportunity after the completion of these preparations.

In all methods of air-survey it is necessary to make good photographs. Good photography depends both on machine and crew. Some of the early work in Switzerland was hindered by machines unsuitable for the work and in which the necessary co-operation between pilot and photographer was impossible; in these machines, further, the aeronautical performance did not come up to the requirements of work in the Alps and the vibration was excessive. The Grundbuchvermessung now owns a machine, a high-wing monoplane, type B.F.W. (Bayerische Flugzeug Werke A-G), M 18c, which was bought in 1929. It is fitted with a Siddeley-Lynx engine, supercharged, of 225 H.P. The maximum speed is 175 km. per hour, and during photography the machine is throttled down to between 90 and 120 km. per hour. The climbing performance is good: the machine climbs from the aerodrome at 450 m. to a height of 5000 m. above sea-level in twenty minutes. The maximum guaranteed height for work is 6500 m., but during a test in which oxygen was used the machine was perfectly stable at 8200 m. It would appear to be a very suitable machine for survey work.

The pilot and photographer are permanently attached for survey duties. Both understand the work thoroughly and carry out all the office work, preparation of flying plans, keeping of records, etc., themselves. They state that the preparation of a good scheme of flying is at least as important as the reconnaissance carried out by the photogrammeter on the ground. It certainly

very seldom occurs that a negative is faulty or that a series contains a "window," *i.e.* a gap that is not photographed.

Photographs are made with the Wild camera or with a special double camera which exposes plates that are later plotted in the Zeiss Stereoplanigraph belonging to Herr Bosshardt in St. Gallen. In both cases, photographs are made so that the overlap used in the plotting is 100 per cent., *i.e.* the photographs are convergent. In the double camera this follows from the fore-and-aft disposition of the apparatus. With the Wild camera, the camera is shifted against stops so that the photographs are alternately "low obliques," inclined 15° from the vertical in a forward direction, and verticals. When the intervals are such that the overlap is 100 per cent., the ratios of base to height above the ground is about 1 : $3\frac{1}{2}$.

The photographs are developed and printed by the flying crew at the aerodrome. From the prints, points are chosen which must be surveyed on the ground to provide control for each pair of plates. In the course of this work the detail that is to be plotted is marked up by the field-surveyor in ink. A complete description of the procedure will be found in a paper by R. Bosshardt (1931).

During the summer following the plotting from the photographs the usual procedure of checking, of filling in gaps, and of ascertaining nomenclature must be carried out by the field-surveyor. Before the map is finally accepted by the Cadastral Survey it must be examined and proved.

A few interesting statistics taken from the experience of the Cadastral Survey may be mentioned in conclusion. It is unprofitable to attempt the aerial survey of a district smaller than 20 sq. km.; a suitable size to treat as a unit is 100 sq. km. The average total cost of the preparation of cadastral map and topographical "Uebersichtsplan" by these methods, including flying costs but excluding the IVth order triangulation, is 800 Swiss francs per sq. km. This is at least 15 per cent. cheaper than by the use of terrestrial photogrammetry and up to 30 per cent. cheaper than a plane-table survey. The cost may be taken as less than 1 per cent. of the value of the property. If the aeroplane makes photographs of 500 sq. km. in the course of the summer—and this figure is exceeded without any difficulty—the flying costs, including the crew, fuel, insurance, and sinking fund, represent 10 per cent. of the total; the marking of points on the ground 3·75 per cent.; the photographic work 1·25 per cent., and the remaining survey and plotting duties undertaken by the private firm represent 85 per cent. of the total cost.

*Presentation of the Topographical Atlas*

Publication of the new map has not yet begun, nor have the details of style and presentation been settled. Certain facts we know already. It has been decided to issue the map uniformly on the scale of 1 : 50,000 over the whole country. This decision was not reached without some discussion, but eventually the military view prevailed, namely that insufficient advantage was to be gained from a larger scale of publication (3 : 100,000 was mentioned) to justify the greater expense. The contours we know to be made at 20-m. intervals, with a heavier line at every 200 m. The projection will be an oblique Mercator, which is an orthomorphic projection particularly suited to Switzerland.

To gain some idea of the appearance of the new map we can probably turn with some confidence to the examples prepared by the Swiss Federal Survey for the International Geographical Congress in Paris (September 1931), apropos the question "Figuration de Terrain dans la Haute Montagne." The experimental map sections are quietly toned and recall in their presentation of form both the new 5th (Relief) edition of the Ordnance Survey One-Inch and the best features of the Siegfried map. In addition to the contours and the "Fels-Zeichnung" of the older map there is hill-shading with lighting from the north-west which gives a very pleasant impression of relief. The style of lettering of the Siegfried sheets is retained, but a novelty is the green tint over the woods. The only possible criticism would be that the whole map could be with advantage enlarged in order to be able to show more clearly the great amount of detail which it contains.

## APPENDIX. THE QUESTION OF CONTROL

Plotting by means of stereo-autographic machinery is agreeable when two controls can be seen in every pair of photographs. One control is necessary to eliminate slight *errors;* but if there is a *mistake*, for instance a wrong setting of the angle of swing, or a point wrongly plotted on to the glass-plate, the more control that is available the better.

An approximate rule is that as much can be seen in properly exposed photographs after setting them in the Autograph as can be made out with six times field-glasses by an observer at the camera-station in the field. Under favourable conditions I have been able to use as a control a beacon at a distance of 5 km. But no reliance should be laid on seeing a beacon beyond 2–2½ km., even under favourable conditions. When photographs are taken against the light, beacons are very often not to be made out at all. A chalet gable, on the other hand, may be seen up to a very great distance.

Under the Swiss conditions that have been explained in the foregoing paper it is probable that from a principal station at least one beacon will be visible and also a number of topographical points to which angles were taken by the engineer carrying out the triangulation. But in the high Alps the favourable conditions may not be so frequently obtainable as the photogrammeter might wish.

There has been some misconception through deduction from the case of Switzerland. Lieut. Salt, R.E., for instance, writes*: "Where any [plotting machines] have been applied to topographical scales (*e.g.* at Bern) the closeness of the control found necessary entirely precludes the method for colonial survey purposes." But the matter should be looked at from another point of view. In Switzerland it was taken as axiomatic that the Cadastral Survey required a dense IVth-order triangulation. Whether this basic assumption is justifiable in the light of recent developments in methods of plotting from air photographs is an interesting question, but a question not immediately relevant. The important point is that all these points are there, and are therefore employed by the topographical survey. But it would be a false deduction to take it that they were indispensable.

It sometimes indeed happens that in Switzerland the usual control is not available. The question then becomes, in which pair of plates is there *one* control to enable the work to be started? So long as there has been no *mistake* in the work, the single point confirms the actual setting of the Autograph. Once

*Salt, *Archiv* (1930), p. 31.

this setting is confirmed, a few conspicuous points may be plotted to be used as control points either for adjacent pairs of plates from the same station or for photographs from another station. Control is thus built up in the office to bridge over a difficult area.

If difficulty is anticipated with control, if in fact a survey were being carried out from a geodetical network no more complete than a IIIrd-order triangulation, procedure would be very different. The photogrammeter would intersect control points as he went along; and every station would be marked with a cairn of stones.

The technique of terrestrial photogrammetry is not a fixed procedure: it must be adapted to the requirements and possibilities of the particular case under consideration. It may be recalled that up to the present there has been no opportunity to develop a technique for a survey where a less severe standard of accuracy is required and where comparatively few trigonometrical points are to hand.

Research and experimental work towards a reduction of the amount of control necessary in air-survey without loss of accuracy in plotting is being undertaken by many workers in the field of stereo-photogrammetry on the continent and in particular by Herr Bosshardt in Switzerland. He is working with the familiar method of bridging a gap between control points by a series of photographs.* The geometry of the arrangement of these photographs in space can be obtained from the stereoplanigraph, and it is only a matter of time and patience before the results reach the very high standard of accuracy demanded by the Swiss Cadastral Survey.

*Literature*

'Geschichte der Dufour-Karte.' (Die Schweizerische Landesvermessung, 1832–1864.) Bern 1896.

HINKS. "Stereographic Survey: the Stereoautograph." *G.J.*, vol. 49 (1922), p. 273.

MACLEOD. "Stereographic Survey: the Autocartograph." *G.J.*, vol. 49 (1922), p. 284.

HUTCHISON and HINKS. "The Photo-Theodolite of Mr. Wild." *G.J.*, vol. 57 (1926), p. 234.

MASON. "The Stereographic Survey of the Shaksgam." *G.J.*, vol. 60 (1927), p. 342.

HINKS. "Mr. Wild's Stereo-plotting machine—the Autograph." *G.J.*, vol. 60 (1927), p. 358.

IMHOF, PROFESSOR ED. "Unsere Landeskarten und ihre weitere Entwicklung." *Schweiz. Zeit. für Vermessungswesen.* XXV. (1927), p. 81.

SCHNEIDER. "Die Photogrammetrie in der Schweiz." *Internat. Archiv. für Photogrammetrie.* VII/I, p. 130 (1930).

SALT. "The present position of Photogrammetry in England." *Internat. Archiv für Photogrammetrie*, VII/I, p. 13 (1930).

BALTENSPERGER and HÄRRY. "Die Anwendung des Photogrammetrischen Aufnahmeverfahrens bei der schweizerischen Grundbuchvermessung." *Schweiz. Zeit. für Vermessungswesen.* March/April 1931.

ZELLER. '*Stereophotogrammetrie* mit besondere Berücksichtigung der photogrammetrischen Instrumente von Heinrich Wild, Heerbrugg.' (Published for the firm, 1930.)

BOSSHARDT. "Erfahrung bei Anwendung der Luftphotogrammetrie für Katastervermessung." *Bildmessung und Luftbildwesen*, VI. (1931), p. 1.

*See Bosshardt (1931).

## DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: The subject of the lecture this afternoon is very technical; indeed, I do not think I am exaggerating when I say that there are few people who really understand it. Mr. Spender is one of those who do. Having been educated at Oxford, he went on the Barrier Reef Expedition. For the past year he has been at Zürich and Berlin, studying the matter on which he will address us this afternoon.

*Mr. Spender then read the paper printed above, and a discussion followed.*

Brigadier H. J. L. WINTERBOTHAM (Director-General, Ordnance Survey): It is delightful to hear about the deeds of our Swiss colleagues; we have learned a great deal from them in the past and shall continue to learn a great deal from them in the future. It is delightful, too, to hear further details about stereo-photo-topography; it is a method of great significance if you have the proper scenery. And it is delightful, as a third thing, to see in the audience this afternoon the daughter of the particularly distinguished Swiss instrument-maker who is responsible for the design of this surveying instrument.

Now we older surveyors are sometimes chaffed as obstinate die-hards in our ill-chosen methods because we do not immediately adopt new photo-topographical ideas in England. Indeed we are not new to this subject in England. Captain Vivian Thompson, for example, who many years before the war was an Instructor in the Survey School at Chatham, was one of those pioneers who nailed a most important rung to the ladder of progress in this very subject. The fact is that when Surrey and the Kingdom of Fife grow formidable mountains we shall survey them photo-stereoscopically. When Dr. Simpson of the Air Ministry can promise us a fine day three days ahead we shall take to air-photos. When in Africa Kilimanjaro is as well known as the Jungfrau; when Entebbe and Kampala are lit by power from Ruwenzori; and when the good folk of Kenya indulge in ski-ing on their native mountain we shall take to a stereo-autograph in Africa. And as to the air-photo we shall take to that with particular gladness when the price per photograph sinks to something like five shillings a time instead of one pound. These little practical difficulties are what hold the hand of cautious people like ourselves, and meanwhile we can but watch and admire the methods which the Swiss have so happily evolved for the very beautiful country in which they live.

I should like to congratulate the lecturer on his slides, and I should like to thank him for a very nice little tribute to the new 5th (Relief) edition of the Ordnance Survey One-inch.

Colonel M. N. MACLEOD (Chief of the Geographical Section, General Staff): One of the first points which interested me was the lecturer's remark that the existing Swiss map was considered to be unsatisfactory. By comparison with the maps which exist pretty nearly everywhere else in the world the existing Swiss map is really a very good map indeed, and it struck me as being rather remarkable that, good though it is, the Swiss are still not satisfied and feel justified in going to the very considerable expense of making a new map by the methods which Mr. Spender has described to us. In the course of my work recently I have had on one or two occasions to try to justify topographical mapping of colonies and other places, and certainly my experience is that Governments seem to require a very great deal of persuading to spend money on maps which are invariably less expensive and less elaborate than this new Swiss production. Of course the Swiss, not only financially but technically, have what is probably a unique problem. Their mountains are a national asset. But consider a country like India and you will realize that for economic purposes the high Himalayas are not

of very much value. I cannot see a stereo-photogrammetric survey of this kind being justifiable in the Himalayas on economic grounds for a very long time to come. The survey of the Himalayas with this degree of accuracy would be impossible, I think, by men on foot. At the same time, I can hardly visualize this degree of accuracy ever being required, and that brings me on to the next point.

What should be the standard of accuracy which the topographical surveyor should aim at? Let us take, for example, the 1 : 50,000 map. Hitherto that type of map has been done mainly on the plane-table. The surveyor fixes with the plane-table a certain number of points, perhaps two or three to the square mile; in some cases perhaps more. He fixes the position and height and, aided by those points, he sketches in the contours which are, for the most part, really form-lines drawn by eye and controlled by a number of instrumentally fixed points. That is the most rapid way of completing a map. Now I have no doubt that the methods which Mr. Spender has explained will give a more accurate result than that, but there are very few places where that accuracy can really be used. Contours are mainly required for engineering purposes, for the alignment of roads, and so forth, and in nearly all cases I think it would be necessary to carry out a detailed survey of the site afterwards quite independent of the map with which one started at the beginning; and so it is legitimate to say that in most cases a lower standard of accuracy than is obtainable by the photogrammetric methods is really all that is required or all that is financially or economically justifiable.

There is one more comment I wish to make on these stereo-photogrammetric methods. I do not think Mr. Spender actually said so in the course of his remarks, but in the written version of his paper through which I was looking before coming here this afternoon I notice he mentions that the Swiss have found that these photogrammetric methods are actually more economical than the use of the plane-table; they have considerable experience of both, but they find the photo method pays better. I confess that surprises me, and considering the application of the method elsewhere I cannot visualize any surveyor, however expert, being able to select his camera stations without a map such as the Swiss had to start with: to go into a new country and select photo-stations would be most difficult. It seems to me that in practice even the most experienced surveyor would have to select a great many redundant stations, far more stations than he could use, because of the danger of leaving gaps, and any redundant work is uneconomical. That seems to me rather an objection to photogrammetric methods when applied to new country.

One last point on the economic aspect. You have heard how it is necessary to send back a topographer a second time into the field. That again is a procedure which would seldom, I think, be justified on economic grounds. The plane-tabler, as you know, when he comes into the country classifies the roads and collects a variety of other information which he either records on his plane-table or puts into a notebook so that it is available afterwards. At any rate, he eats the whole cherry at one bite; there is no question of having to go back on the ground a second time. All this leads me to think that the problem with which the Swiss have been dealing, and for which no doubt they have found an excellent answer, is, if not an absolutely unique problem, at any rate very nearly so.

The PRESIDENT: I have no one else in mind to ask to speak, but I feel quite certain there must be men, and perhaps women, present who could add to this discussion. I shall be very glad if those who have anything they can add will speak now.

Lieut. J. S. A. SALT, R.E.: I am only qualified to deal with the more technical side of the subject. The broader aspects of economics have already been dealt with by Brigadier Winterbotham and Colonel MacLeod. It so happens that the

lecturer and I have already spent at least two cheerful evenings in solid discussion, or argument, and I rather hesitate to bring up any of the points because I know what they lead to! The question raised by Colonel MacLeod as to the almost impossible task of selecting field-stations without a map has, of course, a considerable economic aspect, but I think from the point of view of certain surveys, such as exploratory surveys, it is not really a great disadvantage. Take, for instance, the survey on the German-Russian Alai-Pamir Expedition carried out by R. Finsterwalder,* which seems to me likely to become one of the classical examples of the use of terrestrial photogrammetry on exploratory surveys. There a certain amount of difficulty was encountered in selecting stations, which might prejudice the method for an economic survey over a large area, but which, nevertheless, did not prejudice it for a rapid survey of a small area. It meant that the work in the field could be done in a very short time, and that the greater part of the job could be transferred to the drawing office later. That seems to me the vital aspect of this work in connection with exploratory surveys.

Mr. HINKS: I am glad to have the opportunity, with regard to what Colonel MacLeod said about the difficulty of finding stations, to recall to the meeting the fact that with that instrument before us Major Mason made an extremely successful experiment and produced a very valuable map with this stereogrammetric method in the Shaksgam valley, which certainly by no stretch of imagination could be called a country already mapped. So that it is not quite fair to think about the difficulties of finding stations as prohibitive. But that is not really what I wanted to say. The real question, it seems to me, that interests this Society in particular is the question as to the accuracy with which you are going to map the contours. I have been considerably alarmed to hear people speaking lately of the desirability of restricting contours to very approximate and generalized kind of contours such as we have been more accustomed to call form lines. It seems to me that from the scientific point of view, which we ought all to take, no one could admit such a horrible principle as is implicit in that phrase that I once heard used by an officer of the Survey of India—"a method good enough for the mountains." From the scientific point of view it seems to me we ought to get contours as absolutely accurate as we possibly can, as the Ordnance Survey of England used to try to do on the 1-inch map of England, though by different methods. If I mistake not they pegged out their contours with a water-level and chain-surveyed them. That was perhaps the best method at the time, though certainly not one for the mountains. But I do not think that those who consider it quite sufficient to have generalized contours realize what an enormous amount can be learned from really accurate contours about the mountain in its scientific aspects, especially the geographical and geomorphological. Therefore I do think that in this Society we ought always to insist that contours should be as accurate in detail as they possibly can be made, and not get into the way of thinking that form lines are good enough.

[*Note added on reading the report of discussion:* Colonel MacLeod perhaps exaggerates the duplication of the topographers' work on the ground: is it not rather a rearrangement of order than a duplication of work?]

Mr. SPENDER: My reply to this discussion is concerned with two points. The first is to make it clear that in giving this lecture I have not wished to imply a critical attitude towards certain people who have not adopted these methods of photographic survey. The second is to stress the fact that my purpose has been to get the actual Swiss procedure written down in black and white. To my mind,

*'Photogrammetrie auf Forschungsreisen unter Berücksichtigung der Ergebnisse der Alai-Pamir Expedition 1928,' by Richard Finsterwalder. *Bildmessung und Lufthildwesen*, 4. Jahrgang 1929, Heft 4, and 1930, Heft 1.

the Swiss procedure is the orthodoxy of terrestrial photogrammetry, which when published becomes available as raw material from which the explorer or colonial surveyor may develop a technique to suit his own requirements. To further this end, I am depositing in the Map Room all the relevant field books, calculations, negatives, and records of the terrestrial survey of a small area, in order that they may be available as a complete example of the method.

The Swiss technique is, as might be expected, especially suited for the conditions in Switzerland, somewhat rigid, and has been considerably influenced by the fact of the existence of a dense Fourth Order Triangulation. But terrestrial photogrammetry is nevertheless flexible technically. It will be recalled that in Finsterwalder's survey in the Alai-Pamirs, mentioned by Mr. Salt, no bases were measured; after taking a photograph from one point which he fixed, he moved to another position and exposed his second photograph without fixing the length or direction of the base. The necessary data were worked out later during the course of plotting at the machine.

Bearing this in mind it remains only to mention that the technique treated in this lecture is still capable of development by, amongst other people, Fellows of the Society.

The PRESIDENT: We are glad to welcome Miss Wild here as the daughter of a most distinguished instrument-maker whose work we admire enormously in this Society and in this country. I would ask her to convey to her distinguished father the great pleasure it is to us to see her here, and the equally great—I will not say greater—pleasure it would be to see him here with us. I promised Miss Wild that I would not ask her to speak, but if she will come forward for a moment I would like to introduce her to you; Miss Wild.

Miss LISY WILD: I thank you very much, and when I return to Switzerland I will take my father your message, which I am sure he will be very much interested and gratified to hear.

The PRESIDENT: I am not an expert in these matters, but I realize how much we have to thank Mr. Spender for bringing them before us. I will take an opportunity of telling Brigadier Winterbotham that I hope we shall take more progressive measures in these matters before the time comes that he speaks of. It is not for us only to watch and admire but to take part in these things. Colonel MacLeod has pointed out that Switzerland presents a very different economic problem from our own, for their mountains are part of their country's attractions; nevertheless I feel quite certain that the comments which he made were not in any way meant to be a discouragement to the efforts of our countrymen who study and assist in the use of these scientific instruments. I am sorry that time did not permit of Mr. Spender talking to us and giving us food for discussion on aerial survey. I hope an opportunity will come when we may have an afternoon when that subject can be fully gone into. We had better commence at an earlier hour than five o'clock if we want to get away in decent time, for there is a field before us in aerial survey and aerial navigation and aerial matters of all kinds that will always find the greatest possible encouragement in this Society.

May I take the opportunity—it is the first time we have heard him speak here—of congratulating Lieutenant Salt on the way in which he put forward his views in the short time in which he spoke to us and assure him that on some future occasion we hope that he will come and speak to us again on subjects of which he quite evidently has a most accurate knowledge. And to you, Mr. Spender, may I, on behalf of this audience—a considerably larger audience than we sometimes see at our afternoon meetings—offer you our warm thanks for the very interesting lecture you have given us and for the immense amount of work it is evident you have put into this subject. We hope you will come back again and give us some more information. Thank you very much.

# SOME FURTHER TRACES OF THE FRANKLIN RETREAT

WILLIAM GIBSON

THIS is the narrative of an overland trip along the south coast of King William Island, from Gjoa Haven to the western entrance to Simpson Strait, during the months of June and July 1931, with Mr. William Skinner, of the Hudson's Bay Company. Our principal object was to search for remains of members of the Franklin Expedition, reported by the Eskimo.

Gjoa Haven is an excellent small land-locked harbour on the eastern shore of Petersen Bay, with a post of the Hudson's Bay Company: the trading centre for an extensive area. The harbour was discovered in 1903 by the late Captain Roald Amundsen, during the course of his North-West Passage, and sheltered the *Gjoa* for two consecutive winters.

Striking out from the harbour across the ice of the bay, the western shore is gained in about three hours' walking. At this period of the year the short arctic summer is at hand; the weather is mild and often pleasant; most of the winter snows have disappeared from the land; and the surface of the ice is covered with pools and small lakes of water of varying depths up to 2 or 3 feet. With native water-boots made from seal skin the feet are adequately protected and the surface water is no great impediment to walking.

For this trip we had dispensed with the use of dogs, which allowed us more freedom to examine the shore-line. With the assistance of a native boy we packed what equipment was necessary: a small silk tent, two caribou skins, a light blanket, primus lamp, food, extra boots, etc. The packs weighed about 60 lb. each and proved of no great discomfort, except on those days when the hot sun shone down from an unclouded sky with almost tropical force. For food we depended on the easily procured seal and the small salmon-trout which are obtainable through holes in the lake-ice.

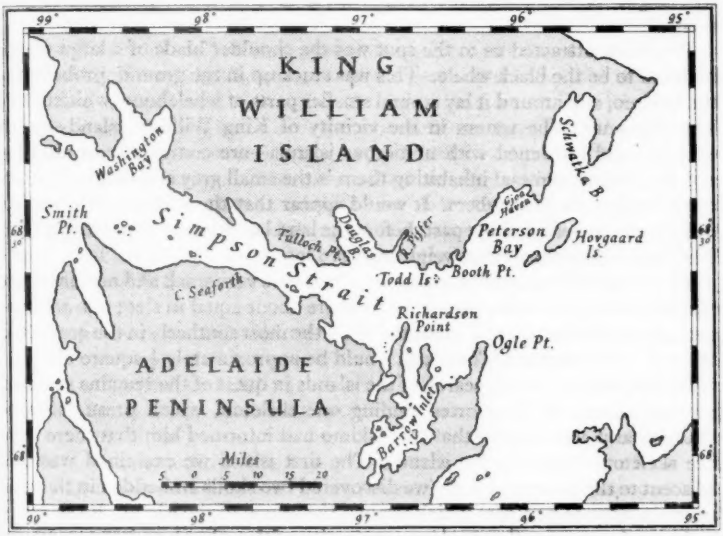
The western shore of Petersen Bay runs south-westerly as far as the Todd Islands, which are 18 miles distant from Gjoa Haven. The island is of limestone, the coast exceedingly rocky and bare of vegetation except in low-lying patches, where mosses, grasses, and a profusion and variety of the hardy alpine flowers lend a pleasing contrast to the sombreness of the landscape in general. The land rises gently from the coast in a series of terraces to an immediate and fairly uniform height of 150 feet; numerous shoals and low rocky islets occur at regular intervals along the beach.

Booth Point, the westerly extremity of Petersen Bay, is not a prominent landmark. Several native stone caches and tent rings were found here; these are quite common all along the coast. At this point we also discovered a number of Eskimo graves, arranged after the manner of surface burial peculiar to the people. A ring of small boulders surrounds the remains, placed on the surface wrapped in caribou or seal skins. Time and weather remove all traces except the whitened bones and the ring of boulders, which latter are symbolical protection from the influence of malicious spirits. On every grave are miniature weapons, fashioned from wood or bone, for the hunters, and diminutive household goods for the women.

Booth Point marks the most easterly point on King William Island at which

remains of the Franklin party were found. Mr. C. F. Hall, the American traveller, who in 1866 examined the south coast for traces of the retreat, reported the interment of one member here. Although we searched carefully for traces of the grave among the boulders and limestone shingle, none were found. If a cairn had been erected over the remains it is very unlikely it would have remained long without molestation by the Eskimo: when once pulled down it would be scarcely distinguishable from the native caches and hummocks of small rock which abound plentifully.

Leaving Booth Point we crossed to a low gravel beach separating the sea from a large freshwater lake. This is probably the largest lake near the south shore and was estimated to be some 4 or 5 square miles in area. The open water along the edges was occupied by large flocks of wild duck; the nesting season




*Sketch-map of the vicinity of Simpson Strait, from Admiralty Chart No. 5101*

for migratory ducks of numerous species, as well as the loon, was already begun, and every little pond contained its share of the visitors. The eiderduck, with the brilliant plumage of the male, predominated. It is difficult to conceive of the contrast at this period of the year, when the climate is so congenial and the land and water teems with life, with that of a short few weeks before with its cold and silence. The outlet from the lake was some 4 miles to the west, where a beautiful little stream, swollen to a freshet, tumbled down to the sea-ice.

Shortly the Todd Islands came into view, dark splotches on the white surface of the sea. From the height of a neighbouring ridge the low land of Richardson Point is visible and seems but a short distance off now it is bare of snow, and shows up darkly on the white horizon. On looking closely Ogle Point is also visible, and brings to memory Captain Back's voyage and survey of the Great Fish River, which ended here.

Opposite the Todd Islands a long high ridge occurs, covered with tundra and comparatively free from boulders and the sharp-edged limestone shingle. The terraces of former beaches are well marked, and some of these hold little ponds, richly bordered with grass and moss. We were interested to find close to the summit the site of an ancient Eskimo settlement, with a number of well-marked mounds from which protruded here and there flat slabs of limestone. At intervals along the arctic coast of America these relics of the stone-and-sod dwellings used by the Eskimo in former days are to be found, and offer rich opportunity for investigation by the ethnologist. They are believed to ante-date the advent of the snow house, the present-day comfortable and mobile dwelling utilized by the Canadian Eskimo. It is significant that their own history and folklore contain no reference or information regarding these old dwellings; indeed, they are not in the least interested in accounting for them.

What first attracted us to the spot was the shoulder blade of a large whale, believed to be the black whale. This was stuck up in the ground, probably by the Eskimo, and around it lay several smaller parts of whalebone, whitened by long exposure. The waters in the vicinity of King William Island—much enclosed and burdened with numerous islands—are comparatively shallow, and the largest mammal inhabiting them is the small grey seal; even these are not present in large numbers. It would appear that the whalebone must date from a remote period of the past, before the land had risen to its present height. This bone was estimated to weigh at least a ton.

The Todd Islands are five in number: three are very small and nothing more than well-defined reefs. The two largest are about equal in size; one adjacent to the King William Island coast, the other the most southerly in the group and about 2 miles offshore. Their area would be approximately $\frac{1}{2}$ square mile.

We began a systematic search of the islands in quest of the remains reported by the Eskimo. Hall reported finding one skeleton, which presumably he interred, and also the fact that the Eskimo had informed him that there were five skeletons in all on the islands. The first island we examined was that adjacent to the coast; presently we discovered two skulls embedded in the sand among a ridge of boulders which formed the crown of the island. By scraping in the sand over a small area a large proportion of the other remains were found. Apparently no burial had ever taken place, nor was there any cairn or other mark erected. Nothing further was found except dark disintegrated shreds mixed with the moist sand, which were believed to be traces of the navy cloth in which the members of the Franklin party were dressed when they abandoned their ships.

The smaller islands disclosed nothing of interest, and we had almost abandoned the other large one, the most southerly in the group, when we were attracted by a skull partially embedded in the sand of a low spit which ran out from the island to the westward. With the removal of a thin layer of sand an almost complete skeleton was revealed, extended in a natural position. The navy cloth was much better preserved here, and pieces could be picked up in the hand and the seams and lining of the material easily identified. The remains were apparently those of a very young man; the teeth of both jaws were intact and perfect to a remarkable degree. A short distance away one femur and some

ribs and spine bones were found, evidently part of a second skeleton. We buried these also, and erected a small cairn as a mark over the grave. With poignant regret for such great sacrifice we carried out this little service, longing that we could more securely and permanently honour the memory of these heroic explorers. This simple cairn will not remain long standing once the Eskimo come across it and their curiosity is aroused. Four skeletons out of the five reported by the Eskimo to Hall were accounted for, but no trace of the grave built by him could be located; it is very probable he marked it with a cairn which the wandering Eskimo afterwards destroyed.

We regained the rocky King William Island coast and progressed west, ever on the look-out for traces of the graves in which Hall had interred three other members of the Franklin party between the Todd Islands and Piffer River, some 15 miles to the west. No traces of these were found however, and it is presumed the cairns or other marks were tumbled down by the natives. A great profusion of caribou bones everywhere litter the ridges and knolls and testify to the presence of large herds in the past and the assiduity with which they were preyed upon. The seasonal migrations from and to the mainland have now practically ceased and the animal is rare on the island. With its disappearance the natives have also changed their summer abodes, being compelled to make hunting excursions into the interior of the mainland.

The interior of the island is much less rocky than the coast-line; broad valleys, mostly of clay and tundra and rich in vegetation, succeed one another. On a bright day in July or August these are very pleasing to the eye, the ponds and lakes sparkling with the reflected light while the mournful wail of the loon lends melancholy life to the scenery. But thick low-lying and chilling fog frequently comes down with the prevalent north-west winds with little warning, and often serves to spoil an otherwise delightful summer day.

After leaving the Todd Islands we had much of this fog until Piffer River was reached; the stream is little more than a large creek, but was now quite imposing as it rushed down between two high banks, swollen to a roar by the melted snows from the interior. The valley of the stream is broad and well covered with vegetation; in fact, it was one of the greenest spots we were to encounter. On the left bank of the stream, at its entrance to the ocean, the remains of Lieutenant Le Vesconte, of H.M.S. *Erebus*, were found by Hall in 1866, and later brought home for burial at Greenwich. We had an Eskimo report that another skeleton remained, and after some time spent in searching the high ground we were rewarded by the discovery, on the low beach about 3 yards from the juncture of the ice and the shore, of one femur and several smaller bones. The femur was of unusual length. From the position in which these remains were found it is very probable the greater part of the skeleton was washed away by high tides. We buried these remains and erected a small cairn as a mark over the spot.

The mouth of Piffer River was crossed on the sea-ice, and in a short distance the general direction of the coast, which is westerly from the Todd Islands, changes to the north-west to form the eastern shore of Douglas Bay, which is one of the deepest indentations in the south coast. The broken coast-line of Adelaide Peninsula can be clearly seen as it runs north-westerly to converge with the island. Tulloch Point is also visible, and is the west arm of Douglas

Bay; it shows up darkly in comparison with the more distant hills on the mainland which appear above it. Several small rocky islets occur in Douglas Bay, which is very shoal. One of these islets was our next objective, although we did not know the exact location from the vague description of the Eskimo; accordingly we struck out across the ice to a group which was just visible through the glasses a short distance to the north of the mouth of the bay, the width of which at this point is from 10 to 12 miles. The ice of the bay contained much surface water and an unusual number of tide cracks had to be negotiated. Seal were quite numerous on the surface of the ice, where they slept and enjoyed the sunshine. At one time we counted as many as seventeen.

On reaching the islets we found them to be little more than exposed reefs, capped by huge boulders which were pushed up in ridges by ice pressure. On proceeding down the bay the following day we encountered further low-lying islets; about 2 miles from the head, and off the eastern shore, was the largest: it was approximately 500 yards long by 150 yards wide and rose to a central ridge of about 30 feet in height. On wading through the shore water and gaining the beach the first object which attracted our attention was a human skull lying above the high-water mark. On circling the island three more skulls and a large collection of human bones were found, while among the boulders on the elevation three further skulls and many bones were also located. There was no doubt in our minds that these remains were those of seven Europeans. There were no native stone caches to be seen, and the only trace of their visitation was two tent rings on the elevation. The island was bare of vegetation and fresh water, and on a close examination for any relics remaining we were rewarded by the discovery of several small pieces of oak and numerous shavings of oak, and what we believed to be Norwegian pine. The pieces of oak were ragged, as if chopped roughly, and of varied sizes up to a few inches in length. Two small pieces of wood, believed to be Norwegian pine, were also picked up, and one of these contained nail holes.

The Eskimo of the present day speak decidedly of a boat which was discovered, broken up, and used by the people after the Franklin disaster. This was said to have been found on the Todd Islands, though some disagreed with this location as the place of the find. No wood or shavings were found on the Todd Islands, and it is probable that we had here on the island in Douglas Bay evidence of breaking up a lifeboat, a number of which we know accompanied the retreat; on the other hand, an oak sled would have accounted for the remnants found, which were undoubtedly caused by the Eskimo fashioning the material to their own uses.

It would appear that this island marked a halt in the march of the retreating crews, and was the site of one of their camps: a camp from which many never rose to pursue the terrible march. The question arises, why did they travel up to within 2 miles of the head of Douglas Bay, instead of crossing the mouth of the inlet to the coast some 10 or 12 miles distant? I believe this can be readily accounted for by the degree of visibility prevailing when they left Tulloch Point, the westerly arm. I have myself, while in the company of an Eskimo well acquainted with the topography, travelled well down in the bay during a day when the drifting snow reduced the visibility to less than a mile or so, before discovering our mistake. The Franklin party, unacquainted with the contour

of the coast, would be even more prone to error. The remains were interred on the highest point of the island and a large cairn erected over the grave. The vicinity is now less frequented by the Eskimo and will, we hope, remain unmolested and free from desecration.

Tulloch Point was the next place visited. As we approached on the bay-ice the conspicuous cairn erected by Hall over the remains of another member of the Franklin party was visible a long way off. The point is fairly high and prominent and covered with rounded boulders. The cairn was found to be composed of a large base of heavy boulders and had apparently been raised to a height of some 6 feet with flat limestone slabs. The top portion was however tumbled down and the centre of the structure excavated, while the remains, which included the skull and principal bones, were scattered around on the ground. It is obvious these were placed in the centre of the cairn about 2 feet from the ground, but did not remain unmolested or secure from the curiosity of the natives, who have no regard whatever for the sanctity of the human remains. We replaced the remains in the cairn and rebuilt the monument to something approaching its former perfection.

Proceeding west from Tulloch Point we enter the confines of Simpson Strait, approaching its narrowest part, which occurs opposite Cape Seaforth on Adelaide Peninsula. The width at this point is only $1\frac{3}{4}$ miles. Five miles west of Tulloch Point, and rising steeply from the water, a conspicuous knoll attains an elevation of some 100 feet. Immediately to the east of the hill a small narrow bight indents the shore and receives the waters of a turbulent stream which had already made inroads on the sea-ice. This was a noted camping ground for the Eskimo in former days when caribou were plentiful on the island. The narrow part of the strait was a favourite crossing for the herds after the formation of the young ice in the fall. Here the Eskimo congregated, and by means of the bow and arrow leisurely acquired sufficient meat to tide them over the greater part of the winter. The knoll was an ideal look-out post from which to espy afar off the approaching herds, which gave ample time for the organization of drives and ambuscades. Tent rings, caches, and a profusion of scattered caribou bones everywhere in the vicinity testified to the past importance of the place as an Eskimo encampment.

Immediately to the west of the knoll a further collection of the ancient stone-and-sod houses was inspected. Several of these were excavated by Mr. Knud Rasmussen in the summer of 1923 in the course of his journey across arctic America. During his sojourn at the spot he utilized a hut of similar construction for his living quarters, the walls of which are still intact and well preserved. An excellent view of the strait is obtainable from the elevation of the knoll; the King William Island coast is fairly regular and well defined, while the Adelaide Peninsula coast-line has a ragged appearance, even when viewed from this distance and angle. Four distinct groups of islands occupy the waters of the strait at a distance from either coast, at intervals for a distance of 12 miles. The largest of these islands is known as Eta by the natives, and occupies a central position in the strait. The southerly channel is navigable while the northerly is extremely shoal. The small schooners plying from Victoria Land to the post at Gjoa Haven each summer experience no difficulty in navigating the strait and have found no less than 7 fathoms throughout its entire length.

Pilotage by a person with previous knowledge of the waters would be desirable, if not essential, to the passage of larger vessels.

A short and pleasant sojourn inland ensued, in the course of which a series of fairly large lakes were inspected, which accounted for the volume of water discharged by the stream already mentioned. Some small salmon-trout were procured through holes in the ice by the native method of fishing, by a hooked line baited with a small piece of seal skin or fish flesh, rapidly raised and lowered beneath the surface until a fish is hooked. The fish can be seen approaching in small schools to investigate the bait, but few succumb to the temptation. Seagulls were quite numerous and were observed nesting on offshore reefs in the lakes. Eiderduck nests were also to be seen in the grasses bordering the ponds.

On gaining the coast the shore-line was traversed for some 15 miles farther to the westward. No further traces of the retreat of the Franklin crews were found, and with reluctance we were obliged to consider retracing our steps to Gjoa Haven. A close examination of the coast-line as far as Victory Point would, I feel sure, result in bringing to light many more of the sad remains not yet discovered. The hope that one day some document or record may be found to throw further light on the tragedy is very remote. The activities of the Eskimo have destroyed all vestige of any evidence except the whitened bones. It is to be hoped that the near future will bring about a movement to inter appropriately all the remains which can be located and collected on King William Island and Adelaide Peninsula. The area is becoming occupied by the agents of civilization, and no economic or other barrier which cannot be conveniently overcome exists to prevent the usages of Christian practice.

The western entrance and approaches to Simpson Strait are greatly obstructed by islands. The cleanest and deepest water is to be found off the King William Island coast. Especially noteworthy and serviceable as landmarks from the west are three high islands, the largest of which attains a height of approximately 200 feet, which with some smaller ones form an irregular chain extending almost completely across the strait; there are two well-defined and deep channels passing through them.

On the return journey we crossed to the vicinity of Cape Seaforth and viewed the coast-line and interior of Adelaide Peninsula from the top of a high eminence about 3 miles inland from the Cape. This is very probably the same hill from which Thomas Simpson, the discoverer of the strait, viewed the surrounding country during the course of his brilliant journey in 1839. The interior of the peninsula is flat and low-lying and interspersed with hills and ridges; innumerable lakes and ponds dot the surface and the marshy flats are covered with a profuse growth of grasses and mosses. The coast-line is very irregular and bordered with numerous small islands and reefs. A series of tiny bays and lagoons occur at intervals, and many of these afford adequate shelter for small vessels. To the westward of Cape Seaforth a narrow canal-like inlet indents the coast for a distance of 4 or 5 miles.

On regaining the King William Island shore the now sun-browned party set out for home. The first week of July was at an end and the shore-water increasing rapidly; the vanguard of the mosquito pest was already a-wing, and the most pleasant period of the short arctic summer almost at an end.

# THE POLAR FRONT

A DIFFERENCE of opinion upon a review in this *Journal* has led the Editor to inquire how far the Scandinavian notion of the "Polar Front" is really represented by the accounts beginning to appear in elementary text-books of Geography and Meteorology. The polar front is there described sometimes as a line and sometimes as a surface separating cold polar winds from warmer temperate or even equatorial winds: a surface of temperature-discontinuity in which a wave is formed. This polar front is said further to have two parts, a warm front and a cold front; or by an extension of the wave idea, it is alternatively described as a wave formed of warm air in front and cold air in the rear. The body of cold air is described as having a sloping upper surface, up which the warm air flows as the warm front of the wave, and breaks like a wave of the sea running up a shingle beach. Unconvincing diagrams are drawn to suggest that this breaking wave is somehow, though vaguely, connected with the formation of a cyclonic disturbance.

Such a Polar Front "theory," as it is wrongly called, for it is if anything a phenomenon and not a theory, appears in elementary books. There it has a certain picturesque swagger; but it is masquerading in a badly fitting terminology, for even if one allows in what should be a scientific description the popular rather than the scientific use of the word "wave," it is still impossible to have a wave warm in front and cold behind.

The Polar Front idea was formed by Norwegian Meteorologists during the years 1914–1918 when they were deprived of the usual meteorological service from combatant countries, and were driven to make the best use they could of stations closely spaced in their own territory. Inspired perhaps by war terminology they used the name "polar front" for a line, or rather a narrow belt, across which the temperature changes rather suddenly by a few degrees Fahrenheit. It is not observable in the passage of all depressions: the older they are the less it is observable. But if you have a recently formed depression coming in from the Atlantic across the British Isles and going on to Scandinavia, you may find occasionally that on the weather map it is possible to trace a line running more or less from W.S.W. to E.N.E. and bulging northwards rather abruptly to pass through the centre of the depression. This pronounced northerly bulge in an otherwise more or less straight line is loosely called a wave. The air just south of the line is some degrees warmer than that just north of it; and as the bulge of warm air moves from west to east the temperature goes up on its arrival and falls when it has passed: hence, more loosely, the warm front and the cold front. Frequently a discontinuity of wind direction is more marked than a discontinuity of temperature; but in many cases the existence of the polar front is inferred from the presence of a more or less narrow belt of rain rather than indicated by any discontinuity of temperature or wind.

The Norwegian Meteorological Services publish a daily map with an elaborate representation of these discontinuities, but it is perhaps not unfair to say that they are drawn as much from the past history of the air-currents as from the actual data on the maps. It is at any rate rare to find any evidence of a simple case on the British weather-maps.

The author of an admirable text-book found one pretty good example in seven years and published it. He was soon approached by another author with the request: May I use your weather map showing the polar front? He consented; but a second like request he refused, feeling that for three authors to have no more than one example between them was giving the case away. Another distinguished meteorologist has recently assured us that he has searched but never found a weather map showing clearly the warm part of the front.

The mere existence of the phenomenon at sea-level is thus not easy to illustrate, and there are strong differences of opinion on most fundamental questions. One thing is certain, that it is very difficult to trace, and still harder to illustrate, what happens when masses of warm air ride up over inclined wedges of cold and side-slip towards the centre of low pressure: and it is a bad mistake to import over-simplified and over-confident accounts of such obscure phenomena into elementary text-books of Geography. A. R. H.

## ARABIA FELIX

ARABIA FELIX: across the empty quarter of Arabia. By BERTRAM THOMAS. *London: Jonathan Cape* 1932. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* xxx + 396 *pages; illustrations and map.* 25*s*

THE traveller in Arabia who places on record an account of his wanderings must be doubly bold: first, he submits himself for comparison with men whose names are honoured throughout the world for fearless and sustained bravery of a most exacting kind—Burckhardt, Burton, Palgrave, Doughty, von Wrede, Wavell; secondly, he dares to enter the lists of eloquence and literature with writers who have made for themselves undying names—Doughty, whose Elizabethan prose has been placed by some critics as second only in beauty, strength, and grace to the Authorised Version of the Bible; Palgrave, Burton, Scawen Blunt, Lawrence. Tested by this high standard, Bertram Thomas's narrative, from the first page to the modest ending [*tammat*], "half an hour later we entered the walls of the fort [Doha]. The Rub' al Khali had been crossed," secures him a triumphal verdict.

He wisely decided on his enterprise in a spirit of secrecy, avoiding—he the Government servant—the frown of official cognizance. Saiyid Sa'id bin Taimur, prince of Oman, alone was privy to the British Wazir's designs. Thomas would land in Arabia Felix, the province of Dhufar, that "Arcadia of luxurious forests, of perennial streams and sunny meadows, of wide vistas and verdant glades," God's limit, according to the writer of Genesis, of the known world "as thou goest East unto Mount Sephar." Thence he would attempt to strike north, through the virgin Rub' al Khali ("the empty Quarter," the great Arabian Desert), "that last unwritten plot of earth big enough for a sizable man's turning in twice or thrice about," as Lawrence describes it, to the port of Doha, not far from "Sandy Bahrein on the Persian Gulf."

He had prepared himself by a previous journey from Salala (west of Kuria Muria Bay) to Al Qurun and the sands of Mugshin, through the territory of Bait Kathir, and the littoral delights of Dhufar were thus no new joy to him. His equipment was as complete as experience, prevision, courage, knowledge of Arabic, three thousand silver dollars, and meticulous attention to detail could

contrive. Humanly speaking he needed but two further allies: good health and good fortune. Neither failed him (his interior economy, like that of Lawrence, seems to have stood much but endured!), although at the very outset he was forced to comparative immobility in and around Jebel Qara. In vain he inquired for Sahail the Rashidi, a comrade of his former journeys, who had sworn to meet him in the mid-moon of Rabi'a al Awwal with a camel party to take him into the great sands. The Rashidi were the only genuine tribe of the Southern Sands: their countenance alone would make the projected journey possible.

To this twice, nay thrice damned delay, as Thomas doubtless felt it to be, the reader owes the fascinating account of several weeks' sojourn at Dhufar (? Dhu Afar, "the Red Country") with its coconut groves, cane, cotton, wheat, and millet fields; of Dhufar's hereditary wars; of the ruins around Khor Ruri (the Moscha of the Periplus): of the subsequent rule there of the House of Muscat through the fearless Wali-Slave Sulaiman bin Suwailim; of several excellent local stories; of negro slaves and devil dances; of Thomas's expedients to obtain victims for his callipers and head-measurement. (Sir Arthur Keith and Dr. Krogman, in an erudite appendix (pp. 301–333), point out that the nearest kin of these Southern Arabs—found to be a most surprisingly Brachicephalic people—is to be sought amongst the tribes on the African side of the Red Sea rather than in the Semitic parts of Northern Arabia. The true Badawin of the north are Dolicocephalic. This is a very interesting thesis: cf. the small-headed Cantonese and the large Shantung Chinese.)

Fretted by three weeks' inactivity, and with the curiosity of the market-place agog as to his plans, Thomas sought to lull suspicion by an expedition to the Qara Mountains, where he could await the return of two Rashidi tribesmen, Ma'yuf and Khuwaitim, to whom, laden with bribes and under solemn oaths, he had entrusted search for the truant Sahail and/or for a camel party to lead him through the Southern Sands northwards. In these Qara Mountains, which seem to have afforded from time immemorial a natural asylum for aborigines or early settlers driven south before more virile peoples, Thomas occupied his enforced wait by shooting hyenas, collecting snakes and butterflies, and observing many interesting sidelights on local customs and *adat:* here he came across a survival of great interest, the blood sacrifice and the burnt offering, faith cures, the custom and method of circumcision, the hyena taboo, the amusing tale of the Prophet, the hyena, and the gazelle, the story of the camel of Salih bin Hut, exorcism of the evil-eye, the ordeal by fire, and the extraordinary practice of "nafakh," as a stimulant to milk production in cows; all which are described in a most racy and interesting manner. At one time, from the scowling attitude of the Qara at Khiyunt, he feared that he might be detained and held for ransom, "a thing never yet done, to my knowledge, in Arabia." He forgets that an instance of holding to ransom occurred in 1920, when Colonel H. F. Jacob, Major Reilly, and their escort were surrounded in the South of Yemen by a tribe at variance with the Imam Yahya of Sana'a, and were so held till the knot was loosed after prolonged negotiations.

Finally, after a disturbed night following on the murder of a Mahri tribesman in a blood-feud, it became obvious that safety no longer lay among the hills, and the party returned to Dhufar. And now came the climax of anxiety. It was 6 December 1930: on the morrow would arrive the Muscat gunboat *Al Sa'idi*, and by her, already signalled from Murbat, Thomas must return. And still no news from the Rashidi. Fortune then smiled. "Muhammad came bounding up the steps. 'News, Sahib! Two Badawin have just arrived from the desert.'" Behind them, with the faithful Ma'yuf and Khuwaitim, were following forty others, bringing with them the renowned Shaikh Salih, a Rashidi of the Southern

Sands. Quickly Thomas sized him up, approved him, swore him to secrecy, and then unfolded his plans, the crossing of the Rub' al Khali from sea to sea. "Impossible, Sahib!" "What is possible, then?" "We can take you into our country, the Rashidi *dira* of the Southern Sands, and bring you back, and God deliver us from the Sa'ar, but we cannot take you into the grazing grounds of another tribe." Moreover no Badu loves travelling in the fast month, Ramadhan; nor can a Badu be browbeaten. But he does understand resolution; and Thomas was above all things resolute. There followed discussion and the hours of night. Next day more discussion; the arrival of the gunboat; a letter from the Sultan; Thomas's quick decision; a reply to the Sultan, that intimate and understanding friend; a final and successful argument with Salih; and the die was cast.

Put in a nutshell, the position was this. Salih's party was to be given to understand that they were to escort Thomas to Dakaka. Once the journey had fairly started Salih would ride ahead to arrange for fresh camels, and, if possible, a Murra *rabia* from Dakaka to meet Thomas and the main body at Dhahiya. At Dhahiya, where the Great Sands begin, the westward journey along the divide, the Umm al Hait, "mother of life," would cease. With a smaller party and with fresh camels the actual northward dash would then commence, *via* Shanna and Farajja. Thence, still northward, through Murra country till Doha in the Qatar peninsula was reached, and the Rub' al Khali had been safely crossed. So much would Salih, under oath of fealty, try to carry out. On his side, Thomas would leave all arrangements to Salih, would be guided by his advice, and would reward his successful services at Doha with gifts, a camel, a rifle, a robe.

Before them now lay some 550 miles of the Great Desert: their route, following of necessity the known waterholes and pasturages, would run roughly north-north-west for 150 miles and then, at Shanna, turn abruptly north. Four hundred miles or so ahead would then lie their terminal point, Doha, on the Persian Gulf. At first the party must be strong enough numerically to evoke respect, if not fear, in any marauding *gom* of the Sa'ar tribe. Had not Salih said "and God deliver us from the Sa'ar"? From youth up he had raided and been raided by these nomads from the south-west, and deep and relentless were the Sa'ar–Rashidi blood-feuds. At the start moreover there must be many camels to carry the baggage, Thomas's specie and instruments, and the riders themselves. Later on, once free of the Sa'ar, and safely provided with a Murra guide, or *rabia*, men and camels could be reduced and every one could breathe more freely. In the meantime life presented a daily danger, especially to Thomas, an "unbeliever," in a desert peopled by fanatical Sons of the Prophet.

At last the start was made, the Southern Steppe climbed, and north-north-west, without any special incident, they raise the divide. In due course Salih slips quietly away and leaves the main body, purposing to rejoin them, with fresh camels and the necessary guide, at Khor Dhahiya. Some days later, by Tof Mitan, there must have come one of the most thrilling moments of Thomas's life. "Suddenly the Arabs pointed to the ground. 'Look, Sahib!' they cried. 'There is the road to Ubar.' 'Ubar,' I wondered. 'It was a great city, our fathers have told us, that existed of old: rich in treasure, with date gardens, and a fort of Red Silver. It now lies buried beneath the sands in Ramlat Shu'ait, some few days to the north.'" Thomas had heard of this Atlantis of the sands on previous journeys, but now his eyes could see "the well-worn tracks, about a hundred yards in cross-section, graven in the plain." Yet it was impossible to turn aside: moreover the tracks are soon lost in the softer sands. Ubar, Wabar, and Ophir: could these be one and the same name? Did Ubar lie on the overland route from Gerrha (on the Persian Gulf) to the frankincense groves of Nejd and Hadhramaut? Did that route thence run on through Wadi Do'an past Shabwa and up

the great Wadi Hadhramaut to Marib and Yemen, in days when the world was younger, and the climate of Southern Arabia softer and damper? Another phenomenon of this part of the journey was the "bellowing cliff" or "singing sands" of Hanaina. Thomas's description of these likens the noise to that of the siren of a moderate-sized steamship, and, like a ship's fog-signal, it ended as abruptly as it had begun. Curzon wrote of "singing sands" in Persia, but we seem to have here the first authentic account by a European who has both seen and heard them.

Steady progress, and Khor Dhahiya was duly reached; after some misgivings, due to the non-appearance of Salih, his camel tracks, the tracks of twenty others, his footmarks and the footmarks of Hamad bin Hadi, a Murra, were identified; for in these sands the Badawin with amazing facility scan and read "a public diary, for all living creatures go unshod." "Each of my companions not only knew at a glance the footmarks of every camel and man of my caravan, but claimed to know those of his absent tribe, and not a few of his enemies." Soon the two parties met; old conversations were repeated and new plans were formulated. In Hamad—headman of one of the subsections of the great Murra tribe—Thomas was to find, for a price, the guide, the *rabia*, or "safety-surety" who would bring him unscathed to Doha.

At Shanna, their duty done, Thomas took leave of his Awamir and Karab *rabias*. Salih's and Hamad's full-fed camels took over the loads of their southern confrères, whose sadly shrunken humps, those barometers of a camel's condition, all too plainly showed the strain of hard travelling and short commons. "Pay day," that curse of desert travel, was at last successfully surmounted. On such occasions each Badu becomes afflicted with a horrid infection of suspicion that he will be, is being, and has been cheated. On this occasion counting and recounting of rupees, first one by one up to 6, 7, 8, etc., then slowly by 1 up to 5, proved vain. It was only when Salih intervened, gathered up all the individual payments, heaped them on his headdress laid out on the sands, and completely redistributed them with much patient discussion, that peace (though not contentment) prevailed at last. A final, and extra, douceur was ultimately granted, and the gordian knot solved by breaking camp with all speed.

Now followed steady days of exacting travel: Hamad night and day on the watch for dreaded Sa'ar *goms*, which, with the Manasir blood-feud which he had inherited, gave him and his companions "many ghostly fears." Good fortune however held; Friday, 10 January 1931, selected by the *rabia* as a "propitious" day, upheld its choice,* and every evening saw the tale of miles reduced, the enforced monotony of the sands being beguiled by the relation of folk stories and legends, of which the saga of Bu Zaid, his sons and his amours, furnishes a most entertaining example.

Shanna lay far behind: Suwaihab was passed; a sand-coloured fox, scarcely bigger than a cat, unknown before to science, was added to the bag of "specimens"; a fragment of a black meteorite was collected in the Buwah sands; and Farajja was safely reached. Gone now was any danger from the Sa'ar† *goms*.

*Throughout South Arabia "propitious" and "unpropitious" days, based possibly on ancient star worship, are common. Strict attention and obedience are paid to, and follow upon, their selection. Among the Murut tribes of Borneo the same observances (but based, in this case, on the flight and direction of flight of birds) are rigidly enforced, and no journey can commence unless the omens are held to be "propitious."

†Thomas remarks thus as to the Sa'ar tribe and its allies: "These are to-day the serious menace to peace in the Southern Sands. Numerically powerful—perhaps 2000 rifles—they derive strength from their remoteness, and have hitherto refused to receive an embassy from Bin Sa'ud."

And, better still, the gossip of the desert—in this fasting month of Ramadhan—proclaimed that the "pax Wahhabitica" of Ibn Sa'ud had shed its mantle over the dreaded Wahhabi marauders.

With the end of his journey at hand, Thomas was able to throw off his habitual restraint; exchange of talk and stories became the order of the day: his electric torch was a wonder to his escort; and their racy legends beguiled the stress of travel; the entertaining tale of Dhiyab bin Ghanim cemented the bonds of friendliness; and the climax of specimen-collecting was surely reached when, for the standard reward of one rupee for each item, a podgy white slug, "a repellent creature which lives in the nostrils of a camel till she sneezes it out," was duly brought along and the fee claimed. Na'aija was the final watering-place: "the last sandhill was left behind, and beyond it rose the towers of Doha, silhouetted against the waters of the Persian Gulf." "The Rub' al Khali had been crossed."

So runs, so ends, a memorable book, ably and modestly written by a brave man. As a feat of competent organization, of sustained courage, of unremitting industry in the collection of desert fables and customs, of systematic mapping, and of accurate observation, Thomas's journey fixes him securely among those rare individuals who have greatly dared and greatly done. Good fortune was an essential to success: he sought it, obtained it, and deserved it.

In his paper, read before the Society in May of last year, the author gave us a striking narrative of the journey in its geographical aspects. The above paragraphs attempt to catch in a review something of the much broader human spirit of the book, with its pages of racy conversation, legends, jests scandalous or grim, its subtle devices, ingenious excuses, and grave reflections. The great exploit of travel is the key to the story, but the narrative embraces much besides: disquisitions on the local laws of inheritance, the methods of frankincense collecting, the use of sardines for cattle fodder, how to reconcile the needs of science and religion in cutting the throat of a museum specimen. And only an occasional chance phrase tells how varied were the impedimenta to easy and comfortable travel. His tent was pitched away from the camp so that he could make observations for position at dead of night; his hours of rest were filled with skinning, bottling, and labelling, and collecting vocabularies. The long years of preparation had taught him how by relentless diligence to observe everything and preserve it. The appendices of museum specialists show how considerable were his collections of material now being worked up. But the greatest part of his acquisitions remains with him. The volume now published is a first rapid survey of the wider field, and his friends are happy to know that when he returns from the States he will have a year or two of leisure in academic calm to ponder and mature his larger work.

W. H. Lee Warner

# IRISH POLITICAL GEOGRAPHY

LA TRANSFORMATION DE LA GÉOGRAPHIE POLITIQUE DE l'Irlande au XVII[e] siècle, dans les cartes et essais anthropogéographiques de Sir William Petty. By Y. M. GOBLET. *Paris: Berger-Levrault* 1930. 2 volumes. 10×6½ *inches*. Vol. I, 1+366 *pages;* Vol. II, 376 *pages*

LES NOMS DE LIEUX IRLANDAIS, dans l'oeuvre géographique de Sir William Petty. By Y. M. GOBLET. *Paris: Berger-Levrault* 1930. 10×6½ *inches;* xx+108 *pages*. 3 *volumes together*, 300 *fr*

THE political geography of Ireland and Sir William Petty are M. Goblet's theme. Each of these has already been the subject of several important works, such as those of W. H. Hardinge, J. P. Prendergast, W. F. Butler, C. H. Hull, and Lord Fitzmaurice, while in recent years the researches of R. Dunlop, T. J. Westropp, T. Chubb, and Mr. Michael Andrews have added greatly to our knowledge of the cartography of Ireland. But M. Goblet has realized that the Down Survey, though undertaken by Petty simply in order to enable the Commonwealth Government to pay its creditors with lands in Ireland, was no ordinary political event, but, through the genius of the man who carried it out, the beginning of scientific geography both in England and Ireland; and writing with imagination as well as wide knowledge, he has produced one of the most valuable books about Ireland which has appeared for several years. The story of the Down Survey and of the 'Hiberniae Delineatio,' as told here, illuminates many interesting sides of seventeenth-century life.

Although between 1172 and 1640 the native Irish had lost possession of their lands in many parts of Leinster, Ulster, and Munster, and notable colonists like Raleigh and Humphrey Gilbert had spent some time there, extremely little was known about the geography of the country. As M. Goblet points out, all the accounts of Ireland published by Englishmen were full of gross errors, many were written as propaganda or in the hope of political reward, and nearly all drew largely from Giraldus Cambrensis's 'Topographia Hibernica,' a work which, though written in 1188, was accepted as in the main authoritative right down to the nineteenth century.—One would like to read M. Goblet's commentary on 'A Brief Character of Ireland,' 1692. After the portolan maps, which are mainly useful for the study of Irish ports and commerce, the only good image of Ireland was in Mercator's maps of Europe and the British Isles, and Boazio's map, which was adopted by Ortelius in 1602. Speed's map, for long the standard one, was based on Mercator's, with additions from Norden's map of the Six Escheated Counties in Ulster, and possibly from that made by Robert Lythe after his survey of 1567 (probably B. M. Cotton, Rot. XIII. 42). There had been partial surveys after successive confiscations, and M. Goblet adds to the list published by Larcom. Desmond was surveyed in 1585, and some maps made. M. Goblet inclines to the belief that Norden was employed in Ireland in 1609 to make a map for Salisbury; Norden's maps of the Six Escheated Counties of 1610 (B.M.) and of Ireland, *c.* 1609 (P.R.O.), support this theory, but it has not yet been proved. Londonderry and the lands of the London Irish Company were mapped more than once between 1616 and 1622. (It is wrong to say that Thomas Raven supervised the building of the walls of Londonderry. He did some measuring and surveying, but most of the work was carried out by Captain Edward Doddington.) Some of these maps survive in the possession of the Drapers', Ironmongers', Merchant Taylors', and Goldsmiths' Companies. No map has come down from Strafford's scientific survey of Connaught and parts of Munster in 1637–40, for all the documents were destroyed by fire in 1711; but there is little doubt that

maps were made and that they were Petty's chief material for Connaught in the 'Hiberniae Delineatio,' since Connaught was not included in the Down Survey.

Although Petty made a fortune in Ireland, it was scientific curiosity which brought him there in the first place, and zeal for geographical experiment which subsequently led him to have the Civill Survey stopped and himself appointed, in the face of considerable opposition, to carry out the Down Survey. All through his varied life, in turn sailor, student at the Universities of Holland and France, Professor of Anatomy at Oxford, and, after the Restoration, political economist, he was a true child of the age of Hobbs and Boyle. To him, as to Gerard Boate and many others, the ruined Ireland of 1652 was a new region, open country, which offered unequalled opportunities for every kind of agricultural, economic, and political experiment.

The Down Survey, of which M. Goblet gives a very detailed account, was a triumph of organization. In method Petty's chief improvements on earlier surveys were his choice of the parish, the townland and the barony as cadastral, areal, and mapping units respectively, the drawing of all first plans on squared scaled sheets, the rigorous division of the work into carefully graded stages, each carried out by a separate staff, and the close supervision of the topographical compasses and other instruments used. The unfortunate fact that practically all the maps and books of reference perished in the Irish Record Office in 1922 gives greater value to M. Goblet's careful description of them.

Twenty MS. volumes of descriptions of town-lands, made about 1692 and based on those of the Down Survey, which are now in the Quit Rent Office, are precious as containing the most ancient and authoritative titles to land in Ireland. Probably many maps similar to the maps of the Roberts estates (B.M.), but less ornate, were issued from the Survey Office in Dublin by Taylor, who was Petty's chief collaborator and, like him, ancestor of a noble line, the Marquesses of Headfort. Petty's contract obliged him to give a copy of the relevant map to any grantee of 1000 acres or over who demanded it, and some of these copies may still survive in solicitors' offices. In this connection M. Goblet publishes the good news that Mr. Burnett, Chief of the Quit Rent Office in Dublin, has undertaken the task of reconstructing the parish maps of the Down Survey from the numerous fragmentary descriptions which survive there.

In his second volume the author deals very thoroughly with the 'Hiberniae Delineatio' and the barony maps which were to have formed part of it. Apparently there were two sets of barony maps, one made as a cadastral record for the Cromwellian Settlement, the other drawn for publication in the 'Delineatio.' Of the former set, which never left Ireland, there survive 14 maps in the Quit Rent Office in Dublin and 103 in the archives of the Lansdowne family; the latter set is that now in the Bibliothèque Nationale. Both were made in the Down Survey Offices while the Survey was in progress, 1655–59. M. Goblet's full description of the maps at Paris will be very useful to students who have no opportunity of seeing the originals, and have to be content with the reproductions published by our own Ordnance Survey in 1908.

Petty's main object in undertaking the Down Survey was to produce eventually a modern large-scale atlas of the whole of Ireland. He had seen to it that the construction of an atlas of Ireland formed part of his original contract; but after the Cromwellian Settlement and the Restoration, the Government refused to spend any money on such an object. To make a geographical atlas such as Petty desired it would have been necessary to revise the Down Survey completely, for the Survey maps were political maps, and—to mention only two features—their orography and hydrography were poor. In addition, a survey of Connaught would have been required. Petty was forced to make shift with the material

which he had collected. The general map of Ireland and the maps of the counties and provinces were all drawn, M. Goblet thinks, by 1661, and engraved in Holland about 1663–4, certainly before 1672. Petty probably delayed publication in the hope of receiving a grant from the Government which would enable him to include the maps of the baronies in his atlas. But all he got was a Royal privilege.

Having shown fairly conclusively that both the portrait—which bears the only date in the atlas, 1683—and the Royal privilege were additions and not integral parts of any edition of the work, M. Goblet dates the first edition of the 'Delineatio' at 1685. His grounds are Petty's will and the definite statement by Wood, who was a friend of Petty's. The Term Catalogues, which he does not quote, confirm this date. The second edition, published by George Grierson, he dates between 1730 and 1751, these limits being fixed by the watermarks of the paper and the death of Henry, Earl of Shelburne, to whom the dedication is addressed. On the difficult question of distinguishing atlases of the two editions when, as frequently happens, Grierson's dedication is wanting, he finds that the critical differences are in the cartouches on the map of Ireland and in the watermarks. He does not mention however that the second and third (1875) editions can be distinguished by the occurrence, on the maps of counties Cork, Kerry, Donegal, and Galway, of the name of the county at the edge of the sheet; these were added on the plate after the printing of the first edition. Nor does he note the existence of two anonymous and very close imitations of Petty's maps. One is a map of Donegal, which replaces the true Donegal in the Hon. Thomas Grenville's copy of the second edition (B.M.). The other is a large map of Ireland, made up of county maps joined together (B.M.); here the maps are slightly smaller and have fewer place-names than the true county maps. Neither of these was printed from Petty's plates.

We know very little indeed about the methods followed for the printing, binding, and sale of the first two editions of the atlas. From the variety of papers used in the larger maps, where two or more pieces were employed, and from the difference in strength of the impressions, it seems probable that copies of the first edition were printed as occasion demanded over a relatively long period of time, perhaps until Petty's death (1687). Petty must have kept a man employed in printing, and probably refused orders for anything less than the complete atlas. Grierson seems to have followed a similar course. It is curious that he did not put his imprint on the atlas, for he states in his dedication that Lord Shelburne had released the plates "for the public good," and therefore had presumably abandoned his Royal privilege. To the sixteen copies of the 'Delineatio' reported by M. Goblet the present writer can add another, apparently of the first edition.

The maps of both the Down Survey and the 'Delineatio' show the area of Ireland and of its parts as less than reality, although the configuration is always comparatively correct. The reduction varies from 7 to 25 per cent. in different maps but averages over 10 per cent. for the whole of Ireland. This has caused some writers to suspect Petty of falsifying the results of the Survey in order to give the grantees, in return for bribes, more land than they were shown to receive on paper. M. Goblet rejects this accusation as a slander, but is unable to explain the error.

The author's critical list of the numerous maps based on those of the 'Delineatio' which were published between 1685 and 1792 is a list of practically all the good maps of Ireland issued in that period. He refers severely to the map catalogues (such as that of the British Museum) which include under Petty's works 'A Geographicall Description of ye Kingdom of Ireland,' an atlas which was engraved by Lamb and published about 1685. The atlas is indeed a wretched little affair, but as the title-page states definitely that it is based on Petty's maps,

every conscientious cataloguer is bound to make a cross-reference to it under Petty. As for another derivative work, the 'New Mapp of Ireland,' by James Moxon, M. Goblet rightly questions the highly improbable date—1675—assigned to it in the British Museum Catalogue. As a matter of fact, the dedication to Christopher Seton fixes the date at 1704–5.

With the 'Hiberniae Delineatio' Petty's work on the geography of Ireland ended, for he never had the patience or the time to compose the geographical descriptions which were to have been included in that work. But he had learned from the Down Survey the habit of geographical observation, of grounding his economic and political theories on the facts of the map; and that influenced all his later writings. The two later works which deal with Ireland, the 'Political Anatomy of Ireland' (*c.* 1672), and the 'Treatise of Ireland' (1687), show the seventeenth-century theorist, with brilliant ideas but imperfect knowledge, groping his way into political geography, and evolving schemes for the solution of the Irish problems which would be ludicrous if the next two centuries had not proved them to be in many ways prophetic. Ireland was always, to Petty's mind, "a political animal." His work and residence there assisted in the development of his plans for the formation of a British Empire protected by British seas; and he proposed, among other things, to transport a large proportion of the Irish to England and to turn Ireland into a vast dairy ranch administered by a small number of English colonists and worked by the residue of the native Irish, who would form a permanent labouring class. He had a somewhat similar scheme for the Scottish Highlands, and thought that the Irish and Scottish immigrants would be a benefit to England in that they would increase consumption and also increase the most desirable kind of population, population collected into large cities.

Whatever the twentieth century may think of Petty's abilities as an economist or of the efficacy of the Cromwellian Settlement, the Down Survey stands as the first systematic description and the first cadastral register of any country in the world. Its by-product, the 'Hiberniae Delineatio' and the barony maps, were—in M. Goblet's view, and few who read this book will disagree with him—a greater and more enduring work than the Settlement. For they were a geographical achievement which was not surpassed for well over a century and is still of great value. And their author was a pioneer—a blundering one, but one who inspired—in all the sciences connected with geography. More, he aroused a scientific interest in Ireland, in her geography, economics, and history, which since the time of his disciple, William Molyneux, has never abated. M. Goblet resembles Petty, the Dr. Petty of the Down Survey, in that he has accomplished far more than his task.

'Les Noms de Lieux Irlandais' is a collection of notes, which forms a supplement to the works of Father Hogan and P. W. Joyce on Irish place-names, and adds a good deal to what C. Litton Falkiner has written on administrative divisions in Ireland. M. Goblet is fascinated, as is natural, by the wealth of history, folk-lore, and poetry which he finds in Irish place-names; but he has learned to beware of the *Dinnseanchus*, and also probably of the delightful interpretations of place-names which many modern Irish peasants can produce to order. His study of the old Irish land divisions—the ploughland, seisreagh, ballyboe, carrow, carew, ballybetagh, tuath and barony—brings him back to the dawn of Irish history, and will be very useful to students. The Irish acre, which was 65 per cent. larger than the English acre, was adopted for grants of land by both Strafford and Petty, and became known as "Irish plantation measure." This course pleased the colonists, but, like all the Irish measures, it confused surveyors and made the Down Survey more difficult. E. L.

# REVIEWS

## EUROPE

THE PLACE-NAMES OF GALLOWAY: Their Origin and Meaning Considered. By Sir HERBERT MAXWELL. *Glasgow: Jackson, Wylie & Co.* 1930. 9×6 *inches;* xlvi+278 *pages.* 21*s*

SCOTTISH PLACE-NAMES. By W. C. MACKENZIE. *London: Kegan Paul, Trench, Trubner & Co.* 1931. 9×6 *inches;* xii+320 *pages.* 15*s*

PLACE-NAMES OF GLENGARRY AND GLENQUOICH AND THEIR Associations. By EDWARD C. ELLICE. (Second and revised edition.) *London: George Routledge & Sons* 1931. 10×6½ *inches;* xii+164 *pages; illustrations and map.* 10*s* 6*d*

Sir Herbert Maxwell has rewritten his 'Studies in the Topography of Galloway' (1887), giving an alphabetical list of some four thousand names in his ancestral province, including a number of field names, all with stress indicated, and also such record forms as are available. The list is of real value for reference and comparison. It shows very clearly the preponderance of the Gaelic element; there is also a distinct, though comparatively small, number of British or Welsh names, and a few names of Norse and of fairly old English origin. As Gaelic has been long dead in Galloway, traditional forms are lacking; all names are more or less anglicized. Old record forms, too, are unfortunately rather few. When in addition the author's knowledge of Gaelic is slight and inaccurate, reliable results cannot be expected in the way of reconstruction and interpretation. Many errors might have been avoided—*e.g.* the explanation of Clachan, a Kirktown, as "stones"; the confusion between *mōin*, fem., gen. *mōnadh*, a moss, and *mŏnadh*, mas., gen. *mŏnaidh*, a hill moor; the assertion that *Amhalghaidh* (not *-adh*) is "the cumbrous Celtic rendering of the name succinctly written Olaf in Norse" (pp. 24, 205); that *casán*, a path, "is akin to English causeway" (p. 2); that *daingean*, a stronghold, is "a Celtic rendering of the Norman *donjon*" (p. 108), and so on. Impossible reconstructions are numerous, *e.g.* Curnelloch from *cor 'n eilidh* (properly *cor na h-eilte*), "the red hind's peak," where *eilid*, a hind, is made masculine and given an impossible genitive.

The sprinkling of British names is found all over. The author regards these as an infiltration from Strath Clyde; the sounder view, in our opinion, is that Galloway, like Strath Clyde and Ayrshire, was British in speech before it became Gaelic. Much of Ayrshire (British of old) is as Gaelic as Galloway, with much the same proportion now of British names. The most interesting old-English name is Whithorn, "white house," the site of Ninian's Candida Casa. Sir Herbert Maxwell thinks Candida Casa a translation from English; it is more likely to be translated from an old British name. The Abbey of Saulseat, in Latin "Sedes Animarum," may be taken at its face value rather than from *sawl sceot*, which should yield now "Saulshot." Norse names are very few. Criffel however cannot be from *kraku-fjall*, "crow's hill," which would give "Crackel" or the like. Reference to a well-known charter of William of Scotland will show that the statement "it is believed that a toll used to be levied" at the Taxing Stone, known from of old as Lachtalpen, "Alpin's grave," needs no qualification: the charter expressly enjoins the giving and receiving there of toll and other customs. Durness parish is not in Caithness (p. 96); Kilmalie is in Inverness-shire, not in Argyll (p. 99). Drumnadrochit is not on the Highland Railway—a misstatement even when the railway was so named (p. 119).

Mr. W. C. Mackenzie's book is intended as (1) a survey of Scottish place-names,

Celtic, Norse, and English; (2) a criticism of previous work in the same field; (3) a basis for certain ethnological speculations. It aims further at being "both readable and reliable." The work has involved considerable reading, and it is unfortunate that the results, so far as they are original, are vitiated by lack of philological equipment and by defective method. Grimm's Law is violated by the equation of Latin *collis*, a hill, and O. Norse *kollr*, a summit; Hebudes (Pliny) or Eboudai (Ptolemy), now the Hebrides, is compared with modern Welsh *heb-ydd*, "cornless," thus suggesting that the Hebrideans spoke modern Welsh in A.D. 1; "Scythian" is connected with Gaelic *saighead*, Welsh *saeth*, an arrow, both loans from Lat. *sagitta*. Inside Celtic there is much wild work. Dictionaries such as O'Reilly's and Owen Pughe's have to be controlled by a sound knowledge of the literature; a number of the terms relied on are ill attested or ghost words; Cormac's Glossary, quoted in support of derivations of Edinburgh, Avoch, etc., is misunderstood. The true traditional forms of many Gaelic names are ascertainable and form data of first-rate importance; these the author has neglected for the anglicized forms found on maps, *e.g.* Coilantogle is given as from *eóchaill*, a yew wood, the real name thus anglicized being well known in the district as *Cùil an t-Seogail*, "nook of the rye." We regret to say that among numerous speculations we can quote none that throw new and reliable light on names of Celtic origin.

On p. 290 it is stated that "by the third century an alien element from Northern Europe, represented by the people known to historians as Picts, had been introduced, bringing with it a Teutonic language." In support of this theory he adduces alleged Norse or Teutonic names from Shetland to Tweed; names mentioned by Adamnan a hundred years before the coming of the Norsemen, *e.g.* Iona and Eigg, are confidently derived from O. Norse. He is "well aware of the chronological difficulty," but he is "not concerned with that objection" (p. 138). This heroic dismissal of history requires much more solid justification: the ancient forms of Iona and Eigg cannot be explained from Norse, but they can be, and have been, explained from Celtic. Vecturiones, the fourth-century name of one of the two *gentes* of the Picts, corrected by Rhys to Verturiones, is suggested to be "a corrupt Latin form of *Vikverjar*, "people of the bays." In the attempted derivations from Norse of names like Logie, Laggan, Tréig, Brechin, Scone, etc., the proved laws of phonetic change as between O.N. and Gaelic are ignored. "In Aberdeenshire there is a stream called The Vat, which it is difficult to believe can mean anything but The Water" (O.N. *vatn*). The name is "Burn of Vat"; the "Vat" or cauldron is described as a wonderful natural curiosity in the Old Stat. Account (xii, 226), and, with striking photographs, in the *Journal* of the Cairngorm Club (July 1915). In our opinion the author has failed to prove the existence of any Norse names on the east side south of the Beauly Valley. For genuine Norse names he has helped himself liberally, but without acknowledgment, to the sound work of Macbain and others. His own contribution is marred by neglect of the pronunciation in Gaelic: *e.g.* in Gaelic the initial vowel of Arasaig is long, indicating an original O.N. *ár-óss-vík*, "river's mouth bay," which it is; instead we are offered "Ari's bay," with *a* short. The derivation of *Peithwyr*, Picts, from *pictae* (pp. 276, 277), rests on a corrupt reading of Vegetius; it appears to have been suggested by Owen Pughe's articles *peithas*, *peithiwr*—obviously speculations based on Vegetius.

The new edition of Mr. Ellice's book will be welcome to many, not so much for the explanations of place-names as for the mass of interesting old tradition connected with the places mentioned, as well as the historical sketch up to 1860, including an account of the Ironworks at Invergarry (1727–1736). A most valuable section on the birds of Glen Garry is contributed by Mr. Murdo

Matheson, the local gamekeeper. Extracts from the Glen Quoich Visitors' Book, kept from 1846 to 1863, are of great interest; the book is illustrated with pictures by Lady Dufferin, Lady Norton, Landseer, Doyle, Ross (the miniature painter), Prosper Mérimée, and others, sixteen of which adorn the present volume. Mrs. Ellice's picture of the old school interior (1845) deserves special mention. A reproduction of the 1-inch Ordnance Map of the district completes the work. Some of the names may be mentioned. Corrie Hoo is in Gaelic *Coire Shubh*, "corrie of berries," right at the head of Loch Hourn, *Loch Shubhairn*. The stream of Glen Quoich (*Gleann Cuaich*) had a tutelary genius named Cuachag, who mourned before the death of MacDonald of Glen Garry. Fassie Wood is a part translation of *Coille an Fhasaidh*, "wood of the stance," or resting-place. The Saint of Glen Garry was Fínan, whose church stood on Loch Oich side. Loch Oich itself (*Loch Obhaich*) means "loch of river-place," as Avoch (*Obhach*) in Ross-shire is "river-place." The book is beautifully produced and delightful throughout. W. J. W.

L'AGRICULTURE EN ROUMANIE: Album Statistique. *Bucharest: Ministère de l'Agriculture et des Domaines* 1929. 13 × 17 *inches; 92 pages; maps*

AN AGRICULTURAL ATLAS OF SCOTLAND. By H. J. Wood. *London: George Gill & Sons* 1931. 12 × 10 *inches; 64 pages; maps*

These two atlases differ in many respects, but from some points of view they lend themselves to comparison. The Agricultural Atlas of Scotland is essentially a piece of research the preparation of which must have involved a very great amount of labour. On about a dozen maps of Scotland Mr. Wood has shown by the dot method the distribution of crops and live stock in that country in 1927. The degree of accuracy is indicated by his statement that "the dots in number representing in each case the parish figures were placed within the parish boundary and within the area under crops and grass in each parish." On the basis of these maps Scotland has been divided into its main agricultural regions, typical parishes in each region have been selected, and graphs have been drawn to show the percentage of the agricultural area occupied by each of the more important crops in the selected parishes. The letterpress intended as an explanation and commentary on the facts indicated on the maps and graphs shows an intimate knowledge of agricultural conditions in Scotland, and the student will probably find it the most valuable part of the work.

'L'Agriculture en Roumanie,' on the other hand, is not so much a piece of research work as a skilful presentation of statistical facts. Of the general maps the most instructive are those showing the distribution of soils and vegetation. The crop maps are diagrammatic but useful. For each important crop a map is provided on which is shown by a combination of inscribed squares and colouring the area under that particular crop in each of the forty-eight *départements* of Romania and the percentage of the cultivated land of the *département* occupied by that crop. Other maps constructed more or less on the same principle show the approximate yield per hectare of the chief food crops and the distribution of livestock, forests, and agricultural institutions of various kinds. The crop maps are as a rule based upon the means for the years 1923–7, while the others show the conditions existing in the last year of that period. Facing each of the maps, of which there are about forty in all, are the statistical data on which the map is based, arranged according to the eleven natural regions into which the country is divided.

An examination of these atlases inevitably raises the question of the best method of representing economic conditions. The dot method so much in evidence of recent years may become a danger if it is allowed to replace instead of to illustrate

the statement of statistical facts. Mr. Wood's map showing the distribution of sheep in Scotland is probably as accurate as it is possible to make it, and certain broad generalizations may at once be drawn from it, but it is impossible to state these generalizations with any approach to scientific accuracy. The map obviously shows more sheep in Tweedside than in Deeside, but further than that we cannot go, unless we suggest that whereas the sheep in Deeside might with great difficulty be counted, those in Tweedside are apparently more numerous than stars in the Milky Way. And that is not a scientific statement! On the other hand, the Romanian Atlas gives statistical information in abundance, but the *département* is too large a unit to allow the actual distribution of crops to be shown with the same accuracy as on Mr. Wood's maps. Many features of interest are thus omitted; there is no indication, for example, of the exact position of the agricultural lands in Munténie or of the vineyards in Bessarabia. J. McF.

ECONOMIC GEOGRAPHY OF EUROPE. By W. O. BLANCHARD and S. S. VISHER. *London: McGraw-Hill Publishing Co.* 1931. 9×6 *inches;* viii+508 *pages; illustrations and maps.* 17*s* 6*d*

This work, as the authors explain in their preface, is designed as "a textbook ... adapted to the use of American collegiate students," and this, together with the fact that it has been prepared by American geographers, constitutes not a little of its interest. That the need for a book of this scope to provide an "introductory course" in one aspect of the geography of Europe has been "keenly felt" by teachers in the United States is significant and encouraging, but of its value for these purposes a reviewer here can hardly speak. Few perhaps will now deny the value of critical observations and comments upon ourselves and our neighbours, especially when those comments are so well-informed, friendly, and constructive as are those here presented. At the same time it is a question how far such views should be set before our own young people without some geographical account of their origin. Indeed, it is just because this book sets the geographical study of two great continents, Europe and North America, upon a common footing and enables us for the first time to see them, as it were, with the same sort of vision, that it is so significant and interesting. Our use of it will probably be critical and discriminating, and it may serve to stimulate the production amongst ourselves of a counterpart.

The work is divided into two parts, Part I dealing with Europe as a whole, Part II with the individual countries arranged in three groups: (*a*) North-Western, (*b*) Eastern, (*c*) Southern Europe. This grouping appears to be purely formal and differs markedly from the regional groupings proposed by European geographers.

The general arrangement and method of presentation within the chapters is that commonly followed in American text-books, and there are abundant illustrations (pictures, maps, charts, diagrams, graphs, statistical tables). Many of the diagrams are familiar from other sources—in itself not a disadvantage—but their value is uneven. Some of the graphs, or the texts attaching to them, are obscure, and they, and the cross-references inserted in the text, are so numerous that they will probably defeat their end. Speaking generally, this type of illustration seems to be overdone.

Part I will be found generally useful: it offers a broad systematic survey of European economic development; it is balanced and substantially accurate. The fairness and insight of its conclusions will be felt to derive something from the detachment—in physical fact though not in sympathy—of its authors. The bibliography is fairly full but omits reference to many continental works of importance. Excessive use is made of statistics. Whole blocks of text are little

more than lists which strain attention and memory to the breaking-point. The book "represents a revision of material used . . . in university classes." We seem to have in these passages the notebook poured into print. Minor points of criticism are (i) the treatment of physical geography, which, together with some of the conclusions based thereon, will probably fail to satisfy (*e.g.* the inclusion of Cornwall and Brittany in the North-Western Highlands (p. 31), leading to the description of these areas (pp. 35–37) in terms of Scandinavia (cf. pp. 165, 201)). Cf. amongst other instances, the South-Eastern Plains (pp. 42 ff.); Balkan Peninsula (pp. 44–45); (ii) the treatment of place-names. Despite the somewhat heroic solution attempted, students and teachers will hardly feel their difficulties solved (cf. also the words "Anglican" (p. 165) and "Welchmen" (p. 121)). But taken as a whole the section is excellent. We have presented to us here a series of analytic studies of many important European economic facts and situations. Liberally conceived, and revealing a sense of the importance of historical and social tradition as well as of the natural aptitudes and capacities of peoples, these sketches are informed with a geographical spirit and often contribute to a broader understanding of common themes (cf. the section on mineral production, pp. 63 ff., 71 ff.). British readers will be gratified by the appreciation shown of Britain's role in the development of European and world economy and by the prominence given to our home and imperial economic and commercial organization.

In Part II the individual countries are treated on systematic and somewhat conventional lines though the brief historical introductions are often illuminating. The British Isles hold pride of place; the section devoted to them is on the whole satisfactory and includes, significantly, a section on the Empire, with emphasis on British commerce and trade. Of other countries France, Germany, Russia, and Italy are treated fairly fully, but in general the balance between countries is well held. The same agglomerations of facts and figures occur as in Part I, with interludes of analysis, comment, and generalization. Useful are those sections which deal with such topics as the Rhine, Westphalian industrial region, etc., which do not fit within the framework of any national State. Some slips, misprints, and mistakes have been noticed, but on the whole these chapters will be felt to be reasonably comprehensive and balanced and to give a clear, fair, and substantially accurate presentation.

American text-books are by no means unknown in this country: some are in fairly common use. The intrinsic merits of this work, its subject-matter, and the lack of an equivalent in the English language will tell in its favour. The impartiality and insight of its interpretations will disarm criticism and help to reconcile us to some views which we may not altogether share. On the other hand, the juxtaposition of rigid, and at times almost mechanical, methods with those of wide and free generalization will appear novel, and readers will sigh for a little more evenness and lightness. The book will hardly fulfil all the needs of our advanced students, but its claim to be an introductory text is perhaps modest.

O. H. T. R.

LA FRANCHE COMTÉ. By GEORGES GAZIER. (Les Provinces Françaises; edited by HENRY MARCEL.) *Paris: H. Laurens* 1924. 10×7 *inches;* 236 *pages; illustrations and map.* 20 *fr*

This book is an anthology of excerpts from the works of various authors who have written on *la Franche Comté.* The authors include Ch. Nodier, Ruskin, Goethe, Lamartine, Julius Caesar, Saint-Simon, Voltaire, Balzac, Michelet, and Jules Breton, among others. Extracts from Xavier Marmier dealing with the life and industries of the Jura will be interesting to geographers. The anthology is preceded by a very useful descriptive study (109 pages) of the country, under the

headings of *le Sol* and *les Habitants*. After a brief general account of the geology, the subject is treated regionally under the headings of the Gate of Burgundy, the plain of the Upper Saône and the Jura, with the subdivisions of *Vignoble*, *Plateaux*, and *Montagne*.

The book is illustrated by 120 engravings, about a third of which make useful geographical illustrations. Although slight, one can recommend the book for the perusal of any one about to visit *la Franche Comté*. H. O.

DIE NACHFOLGESTAATEN: ÖSTERREICH, UNGARN, TSCHECHOslowakei und ihre wirtschaftlichen Kräfte. By GERHARD SCHACHER. *Stuttgart: Ferdinand Enke* 1932. 9½×6 *inches;* viii+286 *pages; map. M.*15.20 (*unbound M.*13.20)

Dr. Schacher has already published a book on the Balkan States which, as he says, in a variant of a now familiar phrase, were "europeanized" by the post-war treaties. This he has now followed up by one on three of the Succession States which resulted from the converse process of the "balkanization" of Central Europe. His book is primarily for the economist rather than for the geographer proper, but is of value to the latter particularly because of its ample statistical material, and its concise summaries of the economic bases of the three states of Austria, Hungary, and Czechoslovakia. The statistics are up to date, the year 1930 being included where possible. Even more important is the fact that they are given for series of years, so that the trend of events which led up to the catastrophic year 1931 can be followed.

After a brief Introduction the three states are discussed in the order given above, that is in progression from the smallest and least densely peopled to the largest and most important. The amount of space allotted to each state increases in the same order, but the treatment is similar in all, so that comparisons are readily made. A very short Conclusion sums up the results arrived at, and the book is completed by an index, a bibliography, and a somewhat crude coloured map, the only illustration present. Throughout the treatment is remarkably dispassionate and detached. There is no criticism of the frontiers as laid down in the treaties, no attempt to suggest desirable modifications. The whole purpose is to set out on a statistical basis the effects of the existing conditions, and to consider their bearings upon the present economic difficulties of the three states, of Germany as the great industrial power of Central Europe, and of the world at large.

Any summary of the contents is manifestly impossible, but it may be repeated that the geographer will find here a mass of useful material, set forth in such a fashion that it is easily grasped. In collecting this material and presenting it so clearly the author has performed a very useful service, and his book should be noted in the first place on this account. For example, such topics as beet sugar production are treated with a wealth of detail far beyond that available in ordinary books of reference. Of more general interest, naturally, are the conclusions drawn from the survey. The author states concisely his opinion that the proposed customs union between Germany and Austria was economically sound, but that since it failed owing to clumsy tactics, another more fundamental international solution must be found, if chaos is to be avoided. That solution, he suggests, should be sought first in some form of economic co-ordination between the three Succession States discussed and the other south-eastern States. Once that was achieved the scope of the arrangement might be widened to include Germany. In other words, he thinks that Germany should avoid the appearance of taking the initiative. He regards it as certain that the attempt to create self-sufficing states, cut off from their neighbours by high tariff walls, out of the fragments of

what was, with all its faults of organization, a great economic unit, is doomed to failure. The old Austria-Hungary did play the part of a link between the industrialized areas of west and central Europe and the mainly agricultural communities of the east and south-east, and some recognition of the interdependence of the now dismembered parts is essential for the prosperity of all. M. I. N.

DALMATIA: THE NEW RIVIERA. By GEOFFREY RHODES. *London: Stanley Paul & Co.* 1931. 9½×6 *inches; 288 pages; illustrations and sketch-map.* 18*s*

The whole point of this book, says the author, is to arouse interest in a country that has hitherto been largely ignored by the English traveller, which offers delightful bathing in semi-tropical seas, all the dancing and social amenities of the Lido, combined with fascinating sight-seeing. But though he dangles the Lido as the carrot to draw his tourist, it is with the sight-seeing that he is principally concerned. Clearly Mr. Rhodes knows his region and is fully alive to its beauty and profound historical interest. He gives us a popular account of it as far south as Dubrovnik (Ragusa). He does not hide the fact that Dalmatia is not as easy to travel in as, say, Italy, and he has plenty of good advice for the intending tourist in his chapter of practical hints or his suggested plans for a trip. He includes glimpses of Montenegro and Albania. The book is well illustrated with a number of good photographs, but the sketch-map is very poor. The list of fishing facilities is useful. The bibliography would have been improved by the inclusion of some of the foreign, notably the Italian, books on Dalmatia.

L. C.-M.

AT THE WESTERN GATE OF ITALY: the Western Italian Riviera. By EDWARD and MARGARET BERRY. *London: John Lane* 1931. 7½×5 *inches;* xvi +288 *pages; illustrations and sketch-map.* 8*s* 6*d*

This is much the best book on the Western Italian Riviera in English, the kind of book it is a pleasure to meet with in times when guides to such popular regions are tending more and more to be written by the hustling motorist for the motorist in an even greater hurry. The late Mr. Berry was for many years British Vice-Consul at Bordighera, which he knew as long ago as 1891, and the volume before us, in which he was assisted by his wife, is the result of a life-long study of the district. The ground it covers is not extensive; it stretches from the French frontier at Ventimiglia to Vado, but it contains some of the favourite winter resorts of the English in happier days, Bordighera, San Remo, and Alassio. We are given the history of the valley or town under discussion, followed by a detailed description of all that it contains that is of historical, artistic, or archaeological interest. There is an unobtrusive thoroughness in the scholarly knowledge displayed which inspires confidence and respect. We may instance the points of special interest to which the authors call attention in the old town of San Remo. They have also studied the botany of their region, recording the rare flowers to be found in various places, and they describe from personal knowledge the various local *feste* as well as the fishing activities of a place like Noli. The book is provided with a good large-scale sketch-map, an appendix containing photographs of the most important pictures in the churches, and a useful and well-arranged bibliography. L. C.-M.

## ASIA

AN ENGLISH LADY IN CHINESE TURKESTAN. By Lady MACARTNEY. *London: Ernest Benn* 1931. 8½×5½ *inches; 236 pages; illustrations and sketch-map.* 10*s* 6*d*

This is a pleasant and unpretentious account of life in Kashgar by the wife of Sir George Macartney, so many years the able British representative in that

place. The authoress had her full share of trouble, and the Revolution of 1912 in particular must have been a very harassing time, cut off as the Macartneys were from any possible help from outside. It is indeed rather remarkable that the Russians did not act at once, to protect the town.

Lady Macartney describes well, and with humour, the trials of housekeeping, as well as the difficulties of entertaining a variety of guests all on the look-out for breaches of etiquette. Father Hendriks, the kind and quaint Dutch Catholic priest, is sympathetically mentioned. It may interest the authoress to know that the late Consul-General, Captain G. Sherriff, has had a brass tablet put over the grave. The harmonious relations between Lady Macartney and the Swedish missionaries were a pleasant feature of her stay. Those who knew Kashgar in the still well-remembered days of Sir George Macartney will be glad to read this agreeable account from the pen of their charming hostess. Eligagnus, on p. 119, is a misprint for Eleagnus. The map is a smudge and quite worthless.

R. C. F. S.

TRAILS TO INMOST ASIA. By GEORGE N. ROERICH. *New Haven: Yale University Press (London: Humphrey Milford)* 1931. 10 × 6½ *inches; 504 pages; illustrations and map.* 42*s* 6*d*

This large book is an account of a journey made by Professor N. Roerich, his wife, and son, in Central Asia, from 1925 to 1928. The travellers left Srinagar, followed the Ladak-Karakoram trade route to Khotan, whence they went *via* Kashgar and Kucha to Urumchi, the capital of Sinkiang, and then proceeded *via* Manas to Asiatic Russia and by rail and car to Urga, the former capital of Outer Mongolia. From that place they went first by car, and then by caravan across Tibet to Sikkim, in India.

The first part of the journey from Kashmir through Chinese Turkistan to Russia in Asia followed what is perhaps the best-known route in Central Asia, and a quarter of the book is devoted to an account of this well-worn road; and although it is true that this region, even in the more explored parts, is always liable to produce something new, the Roerichs were not fortunate in this respect. There are statements in the book about Sinkiang that are hardly correct, *e.g.* "Kuchar is connected with Khotan by a desert route following the Keriya river, and receives by that route its share of Khotan trade" (p. 99). This is not the case, as this route is peculiarly hazardous, and almost unknown. No doubt the Khotan river was intended, but even so the bulk of the trade does not follow this route, as it is not practicable for carts. On p. 96 we read that "Aksu has a large colony of Tungans, and all travellers are unanimous in their complaint (*sic*) against their insolence." There are few Tungans, and they are not insolent. Nor is it the usual custom, as we are told on p. 44, to give no food to baggage animals before crossing a pass.

There is a singularly unsympathetic account on p. 117 of the late Yang, the able governor of the province, and it is not fair to the Chinese rulers, who, heaven knows, have faults enough, to say that Ma Titai (of whose end a garbled account is given) was a characteristic figure in the Chinese administration of the New Dominion (p. 67). There is a gruesome picture of the late Ma, taken by a Chinaman in Kashgar, but the poor man was not put to death by crucifixion, but was shot first. The author indulges in some odd innuendoes about the Chinese rule, such as "For some reason the Torgut region was carefully watched by the Chinese" (p. 118); "the apparently peaceful condition of the Province" (p. 118); "at every stage officials came to examine our passports" (p. 124), implying that something unusual was the case. The party had a good deal of trouble in Chinese Turkistan, but the impression is gained that it was often their own fault, partly

because they were always seeing lions on the path, as when a mysterious stranger rides up with a cryptic message (p. 247), or when (p. 243) an inoffensive official is treated as a bandit. After all, conditions in Central Asia are other than elsewhere, and the Chinese, often with good reason, are apt to be suspicious. It is strange that it never seems to have struck the writer that even in Inmost Asia money talks. The account of Ja Lama, the militant priest (Chapter XI), is interesting, but it is a pity that Ossendowski was quoted (p. 223). The chapters on Mongolia and the description of Urga are good, and the bygone glories of the Bogdo Gegen are well told (p. 154), but nowhere do we read a word of regret of the passing of the old order. Those who are interested in Mongolia would do well to read the account in the *Atlantic Monthly* for March 1930, by Mr. F. A. Larson, who knows more of Mongolia than most people living. Chapters XII and XIII concerning the Tsaidam Mongols and the journey across Tsaidam are well worth reading, but the cause attributed to the Mongol revolt in 1912 is doubtfully correct.

The Roerichs's journey across Tibet was marked by great hardships and privation in their detention and treatment at Nagchuka (Chapter XVII). After months of delay, in great misery, the party was finally allowed to proceed, and reached Darjeeling on 26 May 1928.

It is a pity that the book should have so many blemishes, which a little care would have remedied. The words "colorful" and "expedition" appear *ad nauseam*, and oddities like caravaneer, cameleer, nimdah, and spelling alinement and alignment differently in the same place (p. 413) are unsightly. The unusual spelling of some proper names is wholly inexcusable (as though the present confusion were not bad enough); *e.g.* "Vulur" for "Wular" (p. 6), "Yarkend" for "Yarkand," and Kuchean as the adjective of Kuchar (thus spelt). He often deserts the Wade transliteration of Chinese names, but writes Hsin-Chiang for Sin-Kiang, although the accompanying map gives the recognized spelling (cf. also Jungaria for Dzungaria). The laudatory preface by Monsieur Louis Marin is superfluous, and there is a good deal of scientific talk that seems sciolistic and unconvincing. It is hardly worthy of a university press to put on the "jacket" that "of the many attempts to penetrate . . . this forbidden land none have been more successful than the Roerich expedition." Good wine needs no bush, and this puff is simply a libel on the great travellers of the past. What is more, it is clear that the journey was only a qualified success.

In reading the book it is difficult to escape the impression that the Roerichs never mastered the art of travel. If they had read Part II of the Society's 'Hints to Travellers,' taken a couple of good Gurkha orderlies from India, a good cook, and a really good caravan-bashi, they would have achieved more, spent less, and not have suffered as they did. The book is well printed on good paper, and the type is very pleasing. The photographs are poor, and indifferently produced; the impressionist pictures might well have been omitted (any one who has seen the Gyalpo's palace at Leh will shudder at the cubist sketch of it on p. 24). The map is so bad as to be well-nigh useless, and it is impossible to follow the Roerichs's route across Tibet. The price of the book is high. R. C. F. S.

A GEOGRAPHY OF CEYLON. By ELSIE K. COOK. *London: Macmillan & Co.* 1931. $8\frac{1}{2} \times 6$ *inches;* xii + 360 *pages; illustrations and maps.* 6*s*

Those who, deceived by its unassuming title and appearance, may open this book expecting to find the contents of an ordinary school geography within its plain covers, will soon become aware of something exceeding their expectations. For the author has dealt with her subject in accordance with the most comprehensive meaning of the term "Geography," and has set forth a procession of

facts concerning the Historical, Economic, and Human, as well as the Physical Geography of Ceylon that places her book amongst the more important general works on that island. The book is intended for use in the local schools, but the writer, realizing apparently that, taken whole, it may be beyond the digestive powers of the average Sinhalese schoolboy, warns teachers to administer it in measured doses, diluted where desirable with the waters of discretion.

The Historical section begins with excerpts from writings of foreign travellers to Ceylon from the first century A.D. onwards; discusses the importance of the island at all times as a centre of the trade and pilgrimage sea-routes through and about the Far East; dilates upon Ceylonese reactions to the unceasing pressure of Indian influences; outlines the development of modern trade; and closes with a chapter on the effects of European conquests. Physical Geography comprises chapters on Geological Structure, Orography, Drainage, Meteorology, Flora and Fauna. Except that the last two are somewhat meagre, this is good work. The numerous meteorological charts and geographical maps and diagrams are skilfully constructed and very appropriate. The section on Economic Geography contains information on gem-mining, pearl-fishing, and the tea, rubber, and coconut industries, from which Ceylon derives its wealth. The cultivation of padi and various minor products is also dealt with, and stress is laid upon the fact that only one-third of the rice consumed in the country is now grown there. Manufactures are briefly considered, and such statistics of trade as do not appear in other parts of the book are disposed of here in a single page. In Human Geography the evolution of the various races inhabiting Ceylon is traced, and there is much comparison of Sinhalese (Buddhists) with Tamils (Hindus) and of both with Europeans (Christians), including half-castes, Portuguese, British, and others. Idealism and materialism, the caste system, the position of women, education, hygiene, and domestic habits are fully discussed, with no apparent tendency to show Europeans in too favourable a light. The last section is a summary of "Natural Regions" of the island, elucidated by excellent charts.

Curious statements occur here and there. For example, it is said that the Ramayana is "an ancient Tamil legendary history"; that rickshaw coolies habitually read classics while awaiting fares; that "the Ceylonese do not believe in warfare or capital punishment: the British believe in both." And there are others. The illustrations in the text are passable. The index is reliable. W. A. G.

## AFRICA

MISSION DE PROSPECTION DES FORCES HYDRAULIQUES DE l'Afrique Équatoriale Française. [Under the auspices of] République Française. Ministère des Colonies. Rapport d'ensemble. By P. DARNAULT. *Paris: Larose* 1931. 11 × 7½ *inches;* viii + 248 *pages; illustrations and maps.* 90 *fr*

In 1926, in connection with a bill in the French Parliament for providing funds to complete the railway line in French Equatorial Africa from Brazzaville to the sea, the ultimate electrification of the line was foreshadowed, and with this aim in view it became necessary to investigate the natural sources of power available in the region, no reliable data being then in existence. Accordingly, the Minister for the Colonies despatched a "Mission d'Études" under the direction of M. Darnault, an electrical engineer, who, in conjunction with his staff, has carried out a survey of the potential sites of water-power development in French territory on the lower Congo and its tributaries. The volume under notice constitutes a detailed account of the operations of the Mission, with the conclusions and evaluations of power supply which have been made.

The description of the course of procedure is chiefly interesting in that it

relates the various difficulties encountered in a little-known tropical region, beset with physical obstacles, amid untutored races, without the resources of civilization to supply the needs for taking accurate measurements and gauging records. Notwithstanding the necessity of working in a climate extremely trying to Europeans, there were apparently few cases of sickness, the only reference to prolonged incapacity on the part of any of the members of the staff being a note in December 1928 that "l'ingénieur Schumer rentre en France malade." Every consideration seems to have been given to the health and well-being of native servants, and it is stated that, among the large number employed, there were no deaths and no serious accidents.

Of a volume so large in size, packed with numerical and physical data, it is impracticable to make any effective résumé in a small space. The enumeration alone of the rivers and streams which were examined and measured would occupy several columns, and their names would convey little or no meaning except to those conversant with the locality.

The report does not give any definite and comprehensive total of the potential energy available throughout the region, probably because the premises are too uncertain and incomplete. A section headed "Inventaire provisoire des forces hydrauliques de l'A.E.F. (Étiage 1929)" gives estimates for a number of independent falls, the aggregation of which is in the neighbourhood of $3\frac{3}{4}$ to 4 million horse-power at least, apart from a very round and enormous figure of 100 million horse-power for the course of the Congo between Brazzaville and the coast. How much of this latter figure relates to power within French territory does not appear, neither is it altogether clear whether it may not cover some part of the preceding total. The publication is accompanied by a portfolio of charts and plans of all the falls and rapids investigated, and there are numerous photographs, some of them of striking interest, and diagrams showing river levels, discharges, etc.

B. C.

HISTORIC FARMS OF SOUTH AFRICA: the wool, the wheat, and the wine of the 17th and 18th Centuries. By DOROTHEA FAIRBRIDGE. *Oxford: University Press* 1931. $10\frac{1}{2}\times7\frac{1}{2}$ *inches;* xii+194 *pages; illustrations and facsimile maps.* 32*s* 6*d*

In 1651 Johan van Riebeck was commissioned by the Council of Seventeen, the controlling body of the Dutch East India Company, to form a settlement at the Cape for the purpose of founding a place of refreshment for the Dutch fleets sailing to and from India. The plan was to form a garden to grow fresh vegetables, and to trade with the Hottentots for cattle to supply the ships which arrived in Table Bay, their crews often decimated by scurvy. It was never the intention of the East India Company to found a Colony of free farms, and subsequently they endeavoured to thwart all the efforts of the local authorities at the Cape to extend the cultivated area.

Van Riebeck, who remained at the Cape as Commander from 1652 to 1662, introduced into South Africa all the European vegetables as well as vines and fruit trees. The first garden was laid out near the old fort close to where the present Groote Kerk stands, at the top of Adderley Street, but van Riebeck also extended his farming and gardening operations to the other side of Table Mountain, and Groote Schuur—the Great Barn—stands on the site of his granary, while farther up the little Liesbeek River he had a fruit and vine farm called Boscheuval, now the site of Bishops Court, and still showing traces of some of van Riebeck's work.

In this beautiful volume Miss Fairbridge has traced the steps by which the little settlement in Table Bay has expanded into the present South African

Dominion. It is however to the two van der Stels, Simon and Adriaan, father and son, and Commanders respectively from 1679 to 1699 and from 1699 to 1707, that Miss Fairbridge devotes most of her narrative, and it is to these two that the advance of the Cape from a small settlement to a flourishing agricultural colony is due. The elder van der Stel introduced the oak and founded the great wine farm of Constantia; he also brought over the Huguenot refugees from Holland and settled them in the French Hoek Valley where the beautiful farm buildings dotted up and down the Berg River testify to the taste of the builders.

Miss Fairbridge devotes several chapters to Adriaan van der Stel's farm, Vergelegen, near Somerset West, which was the ultimate cause of his dismissal from the governorship. A group of settlers were full of indignation with the administration of the government, and three of their leaders went to Holland to lay their case before the Council of Seventeen. Much stress was laid on the house and lands occupied by the Governor at Vergelegen, and it was on this ground chiefly that the condemnation was based. The Governor was deposed and ordered to return to Holland, his farm was confiscated, and the house ordered to be razed to the ground. Fortunately this order was never carried out, and Vergelegen, with its magnificent row of camphor trees planted by Adriaan, remains to-day one of the show places of the Peninsula.

We regret to learn that Miss Fairbridge, the talented authoress of this work, died last year before this volume appeared, and that this will be the last of her many volumes of the history of her native land to which she was so passionately devoted. A final word must be added in praise of the illustrations, some of them derived from the works of Kolbe and John Barrow, and others from photographs.

W. L. S.

THE BIRDS OF TROPICAL WEST AFRICA. By DAVID ARMITAGE BANNERMAN. Volume II. *London: Crown Agents* 1931. $10\frac{1}{2} \times 7$ *inches;* xxx $+428$ *pages; illustrations and map.* 22*s* 6*d*

The second volume of Mr. Bannerman's beautiful work on West African Birds fully sustains the high standard of the first. It deals with the Rails, Waders, Gulls, Doves, and Parrots, and is provided with ample keys and explanations, and such points for field identification as would enable any one with but the smallest knowledge of birds to identify any specimen he may come across. The coloured plates have been increased from ten to fifteen, and some of the commoner species have been illustrated in colour at the special request of the Colonial Governments. A recent map of the Gold Coast Colony, showing all the railways and the roads of different grades, and prepared and printed in colour by the Survey Department, Accra, is included at the end of the volume. This map is a great credit to the work of the Survey Department of the Gold Coast and is a valuable addition. It is hoped to issue maps of the other three British Colonies in further volumes.

We shall look forward with great interest to the appearance of the remaining volumes.

W. L. S.

## CENTRAL AND SOUTH AMERICA

ARCHIVES OF BRITISH HONDURAS. Volume I. From the earliest date to A.D. 1800. Edited by Major Sir JOHN ALDER BURDON. *London: Published by Authority of the Governor in Council on behalf of the West India Committee by Sifton, Praed & Co.* 1931. $9 \times 5\frac{1}{2}$ *inches;* xvi $+304$ *pages; maps.* 7*s* 6*d*

Sir John Burdon and his band of helpers have rendered a notable service to scholarship by bringing together the scattered and (for the earlier period) frag-

mentary records of this stout-hearted English community, set in the very midst of the Spanish Empire. As a result of the Treaty of Madrid in 1667 for the suppression of privateering, the pirates and buccaneers of Jamaica and elsewhere began to resort to the lucrative alternative of cutting logwood in the Bays of Campeachy and Honduras and along the Moskito shore. The sale of this commodity, "the fundamental fixing dye to almost every other colour," as it was described, had previously been monopolized by the Spaniards, with the result that it fetched in London the high price of £100 per ton. By 1717 the English logwood-cutters were importing into this country sufficient quantities to supply all the European markets, and at much lower but still profitable prices. In 1756 the output had reached the impressive figure of 18,000 tons. It is not, therefore, surprising that Spain regarded this activity as an intolerable intrusion into her preserves. Ever since the famous donation of Pope Alexander VI she had consistently asserted her prescriptive rights in the New World as against the English contention (much less consistently maintained) that possession was only rendered valid by effective occupation.

It was the misfortune of the "Baymen" of Honduras that the British Government did not accede to their repeated requests for recognition as a colony and the protection consequent upon imperial administration. They were merely aliens, living under a hostile jurisdiction, and, as they mournfully expressed it, "only half-British subjects." They thus became a sort of test case in the long struggle between the two Powers during the eighteenth century. The documents calendared in the present volume (drawn for the most part from State Papers in the Record Office) are chiefly concerned with the continuous efforts of Spain by diplomacy, ruthless warfare, and indirect pressure, such as the seduction of the Baymen's slaves, to eliminate these unwelcome settlers.

Lacking proper means for the maintenance of law and order, they were inevitably lawless and turbulent, but their courage and pertinacity were heroic. Their wonderful victory over an apparently overwhelming Spanish force at the Battle of St. George's Cay in 1798 at last brought them security. These records amply justify the remark of Sir Charles Metcalfe, who wrote, when Governor of Jamaica, "I regard the history of British Honduras as affording one of the most remarkable instances of British enterprise and energy."

The Editor's introduction, though somewhat lacking in historical perspective when treating of the larger field of Anglo-Spanish rivalry, provides a very lucid account of the history of the settlement up to 1800. V. T. H.

## AUSTRALASIA AND PACIFIC

MEMORIES OF PIONEER DAYS IN QUEENSLAND. By MARY MACLEOD BANKS. *London: Heath Cranton* 1931. 9×5½ *inches;* 80 *pages; illustrations.* 3*s* 6*d*

These notes of a child's impressions, as they are called by their author, are geographical only in the sense that any account of any part of the Earth's surface at any time is geography. This account is of a grazing station not far from the township of Esk and about 65 miles in a direct line north-west of the city of Brisbane. It relates to a period some seventy years ago when the McConnels had already held for about twenty years the homestead of Cressbrook, which is still in the family, and always known for its kindly hospitality. Conditions have changed since David McConnel settled there. Crinolines and croquet and other fashions and pursuits shared with Mid-Victorian England, buggies and phaetons, sheep and shepherds, and the tribes of "Blacks," so tragically misunderstood and

mishandled, have passed away. The Holstein cow now shares with the Hereford bullock the good natural grasses of the district, and farming has for the most part taken the place of grazing and brought with it closer settlement. But the blue hills, the tall forest gums, the cone-bearing bunyas, and the she-oaks with their pine needles singing in the breeze by the banks of the streams remain as of old. There are still floods and times of drought. If not actually at the homestead there are in the scrub near it kangaroos and native bears. The twitter of the Willy-wagtail and the song of the magpie and of the butcher bird are still heard when there is sun and coolness, and the kookaburra laughs in the early morning. The writer of this note has heard the laughter of young children on the long veranda where Mary McConnel spent many of her young days and where she must have effectually checked the fun of her young brothers by the picture of the Last Judgment she drew for their edification. Her book is slight but her theme is pleasant and brightened by pictures that bring the atmosphere of Queensland to those who have been in the country and love it. M. N.

## POLAR REGIONS

THE SOUTH SANDWICH ISLANDS. By STANLEY KEMP and A. L. NELSON. (Discovery Reports, Vol. III, pp. 133–198.) *Cambridge: University Press* 1931. 12×9½ *inches; illustrations, diagrams, and maps.* 18*s*

The Reports issued by the *Discovery* Committee from time to time are naturally chiefly concerned with the biology of the Southern Seas. Occasionally, as in this Report, they deal with important geographical discoveries which the ships of the Committee are able to make in the course of their investigations of the conditions affecting the life of whales in the southern hemisphere. Here we have a handsome contribution to our knowledge of a group of islands which the favourable season of 1929–30 permitted the R.R.S. *Discovery II* to visit and survey in much greater detail than ever before. Each one of the eleven islands of this extended group was visited, though the weather permitted landing only on the southernmost.

The work begins with a complete history of the discovery of the islands. Islands in the Southern Ocean have a habit of appearing and disappearing in the narratives of different explorers, and the South Sandwich group is no exception to this rule. The Candlemas Islands, situated towards the northern end of the whole festoon, have been reported on different occasions as consisting of one, two, and three islands. It is now finally proved that Captain Cook, the original discoverer, was right in giving two as the correct number, and Dr. Kemp has happily named the second one Vindication Island, as a tribute to him.

There follows a detailed account of each island, which includes as much of the geology and biology as could be observed from the ship. No less than five of the islands show signs of pronounced volcanic activity, either from definite craters, or from fissures and parasitic cones on the slopes. A valuable part of the Report is the series of sketches and profiles, which considerably assist the verbal descriptions in the text. The surveys of each island will be of great use to future navigators, but it must be confessed that they are a little disappointing to the geologist and the student of land forms. The Marine Surveyor must, of course, attend primarily to his soundings and coast-lines, but it is a pity in this case that he should not have given some indication of the surface form of the islands, either by shading or form-lines. In the absence of a geologist on the ship, the authors have done their best to set out the geological evidence they observed,

and, taken with the report on their specimens by Professor Tyrrell, these will be of some value as indicating the kind of volcanic province to which the group belongs. It is probable however that geologists will hesitate to accept the author's conclusion that the bedded rock on Freezeland Peak is sedimentary. In the photographs, at all events, it looks much more likely to consist of stratified tuffs.

Much more of geological interest awaits the fortunate party which is enabled to land on these islands in the future. A very interesting hydrographical discovery was the existence of a submerged crater between Thule and Cook Islands in the south of the group. The Report concludes with a comprehensive series of photographs. It is to be hoped that this successful beginning of a truly geographical investigation will be followed by more of its kind. We are still woefully ignorant of much of the land included in the Falkland Island Dependencies, though we are rapidly amassing knowledge about its hydrography. F. D.

## PHYSICAL AND BIOLOGICAL GEOGRAPHY

BULLETIN OF THE NATIONAL RESEARCH COUNCIL. February 1931. Number 77. Physics of the Earth. I. Volcanology. *Washington, D.C.* 1931. 10×6½ *inches;* viii+78 *pages*

In 1926 the National Research Council of the National Academy of Sciences, Washington, organized a series of Bulletins on the Physics of the Earth. These bulletins, of which this dealing with Volcanology is the first, are designed "to give the reader, presumably a scientist but not a specialist in the subject, an idea of its present status together with a forward-looking summary of its outstanding problems." The Introduction by A. L. Day, Chairman of the Committee on Volcanology, is all too brief, for here are merely mentioned such interesting topics as the relation between meteorology and the volcanic cloud, and the role of magmatic water in the mechanism of paroxysmal eruptions.

The main part of the volume consists of three essays by master investigators in volcanology. In the first, Karl Sapper gives a summary of volcanic phenomena and of the various explanations advanced to explain them. This is followed by Immanuel Friedlaender's account of the present condition and the future of volcanology, which closes with a plea for more volcanological observatories. As an inducement for the expenditure of public moneys on such establishments, there are advanced the possibilities of prediction of volcanic outbursts and of the utilization of volcanoes as sources of energy.

The last essay, on the Mechanism of Volcanoes, is by T. A. Jaggar, Director of the Hawaiian Volcano Observatory. Jaggar conceives volcanism as a process everywhere at work in and under the Earth's crust, so that terrestrial volcanicity is a single unit. The ascent of magma depends upon the dissolved gas as the impelling agent. This gas, in Jaggar's opinion, is sufficient in exothermic heat, expansive power, and chemical activity to produce "a flaming furnace, a frothing slag-pot and a reasonable hydrostatic system." The use of the spectroscope in the study of volcanic gases is cogently urged. Explosive eruptions however are held to be due to the entrance of ground-water consequent upon engulfment; such eruptions are "impure" and are contrasted with the "pure" volcanism of Hawaiian type. Much of Jaggar's essay as presented here is speculative and detailed arguments would be welcomed. The search for what A. L. Day calls the scientific background of volcanology must continue. H. H. R.

## CARTOGRAPHY

INTERNATIONALES ARCHIV FÜR PHOTOGRAMMETRIE (ARCHIV international de photogrammétrie). Edited by F. BAESCHLIN. *Brünn, etc.: Rudolf M. Rohrer* 1930, 1931. 11×6 *inches;* VII. Band. I. Hälfte 1924–1930. viii+202 *pages.* II. Hälfte 1930–1931. x+302 *pages; illustrations and map. Kč.*100 *and* 140

These two half-volumes form the complete report of the International Congress of Photogrammetry held at Zurich, 6–10 September 1930. The first half-volume was published at the time of the Congress itself, while the second half appeared over a year later. The next Congress will be held in Paris in 1934.

*Erste Hälfte.*—Each country taking part in the Congress was asked to submit a report giving an account of the technical progress and photogrammetric activity in that country since 1926. To mitigate language difficulties these accounts are published either in English, French, German, or Spanish. In addition, certain papers are published which were read at the Congress, most of them being in German.

*Zweite Hälfte.*—The work of the Congress was divided up into fourteen separate Commissions, each dealing with a part of the subject, and, as a whole, covering comprehensively the whole range of activities, *e.g.* terrestrial photogrammetry, rectifying instruments, stereophotogrammetry using air photographs, air-photo triangulation, the optics of instruments and standardization, plates and films, economics, training of personnel, aircraft and navigation, and other minor subdivisions. The work of each Commission consisted of a series of papers followed by a discussion which, together with the general report of that Commission, is published in the second half-volume. The language is German, though the reports are also given in French. In addition, two other important papers are included, and further miscellaneous matter.

The precise value of an international congress on such a subject is difficult to assess. At first sight an argument in indifferent German between (say) a Pole and a Brazilian is not conducive to the advancement of science. The colour and vitality of the gathering is also largely determined by those whose mother-tongue is the official language. Viewing the reports in retrospect however the value of the Congress as a clearing-house of ideas is very evident and much useful information may be extracted. A few such marginal notes are given below.

1. The production by Photogrammetrie G.m.b.H. München of the 9-lens Panorama Camera designed by C. Aschenbrenner is an event of first-rate importance. Many considerations, chief among them economy, lead to the desirability of wide-angle lenses. In the case of a single lens of sufficiently wide aperture for air survey work, this limit appears to have been reached. The only line of advance is the development of multi-lens cameras, of which the above is the most noteworthy example. Its use, by reducing the cost of flying, should greatly expand the economic possibilities of air survey.

2. It was generally recognized that the accuracy to be aimed at in the production of a map should be related to the purpose for which it is to be used. This conception of "efficiency" (Nutzziel) should underlie all the operations of any survey organization, and is the principal factor affecting progress in the future.

3. The work of R. Finsterwalder on the German Russian Alai–Pamir Expedition in 1928 may well become the classic example of terrestrial photogrammetry correctly applied and brilliantly executed. The value of the method lies in the possibility of collecting in a short time and storing for a later date a vast amount of data in the field. This is then plotted at leisure afterwards in the drawing office. Its possible use on future exploratory work is of great significance, and in

this connection Finsterwalder's remarks on the factors affecting its applicability should be carefully studied.

4. It was unfortunate that while the Commission on Aircraft and Navigation spent so much time in discussing aircraft, on which every one was virtually agreed, they had no time to discuss navigation, a highly controversial subject. This is not however without its significance.

There was no evidence in the Exhibition of any large area having been covered photographically by skilled navigation. Bad flying ministers to the greater glorification of complicated methods of plotting. Good flying, on the other hand, leads to simpler and speedier methods. The latter is the trend of events in the British Empire. When one remembers the parallel case—observation of a triangulation and its subsequent adjustment—it appears that history is repeating itself. J. S. A. S.

## ECONOMIC AND HISTORICAL GEOGRAPHY

HISTOIRE DE L'EXTRÊME-ORIENT. By RÉNÉ GROUSSET. *Paris: Paul Geuthner* 1929. 10×7 *inches*. 2 vols. Vol. I, xviii+402 *pages;* Vol. II, 403–770 *pages; illustrations and maps*. 250 *fr*

This book, which is an entirely different work from the author's previous 'Histoire de l'Asie,' includes the history of India, China, and Indo-China, but not Japan, beginning with the earliest times. The scope is a wide one. The author includes in his survey both archaeological and literary sources, and covers both the field of political history and of the material arts. As far as China is concerned, the footnotes give in Chinese characters both his authorities and the names, personal, tribal, or topographical, to which he refers in the text. Naturally, even with nearly eight hundred pages at his disposal, the need for compression was great, but M. Grousset has succeeded in making what is in effect a very encyclopaedic work extremely readable. Although it is not primarily geographical, the geographer will find much of interest to him, especially in the accounts of Oriental travellers, the distribution of art and of tribes and languages. It is a pity that exigencies of space did not allow a consideration of the geographical background, for it is abundantly clear that the author is aware of the necessity of considering it. His outline maps are extremely clear, and should prove most useful, especially in showing clearly the historical succession of place-names. The system of transliteration is succinctly explained, so that this bugbear is to a large extent eliminated. The bibliography is extensive, including authorities in many languages, and is a work of great erudition; a few sub-headings would have made it easier to use. L. H. D. B.

JAPAN: a short cultural history. By G. B. SANSOM. (The Cresset Historical Series. Edited by C. G. SELIGMAN.) *London: The Cresset Press* 1931. 10×6 *inches;* xvi+538 *pages; illustrations and sketch-map*. 30*s*

Mr. Sansom has given us a work of great importance and value; and that is not all, for he possesses the rare merit of combining profound scholarship with an admirable literary style. This history contains abundant new information, and, what is perhaps even more important, it dispels numerous erroneous impressions regarding Japan. The popular concept of that country is limited to that of a somnolent and remote Asiatic nation which, soon after the middle of the nineteenth century, suddenly determined to modernize itself; but Mr. Sansom's work will do much to bring that event, and those which have succeeded it, into their true historical perspective.

The work opens with a detailed and critical summing-up of the available

evidence regarding the vexed question of the origins of the Japanese nation, and after treating of its early myths, lore, and cults, passes to its earliest known contacts with the Asiatic mainland; even at this early stage the author keeps well to the foreground those religious and economic factors which enter deeply into the political history of every nation and which he brings out clearly and with admirable simplicity in his recital of Japan's history from A.D. 710 to 1868. In that history it is possible to discern the genesis and development of many of those forces that are operating in the Far East to-day; and Mr. Sansom's work is therefore to be welcomed, not only by the student of history, but by all those who wish to acquaint themselves with the causes of a situation that is attracting the anxious attention of the whole world to-day.

The printing of the book is up to the same high standard as its contents. There are two suggestions which might perhaps be offered: the chronological tables might with advantage have been printed as a consecutive whole at the end of the book, and the titles of its singularly beautiful plates appeared on the plates themselves instead of in a separate list. E. H. de B.

A PRIMER OF ECONOMIC GEOGRAPHY. By L. W. LYDE. (Pitman's Economic Series. General Editor, J. H. JONES.) *London: Sir Isaac Pitman & Sons* 1931. 7½ × 5 *inches;* xii + 208 *pages;* 5*s*

One may rely on Professor Lyde that any book he may choose to write will be both stimulating and provocative, and the present work is certainly no exception. When he says that the attitude of mind of the student is far more important than the body of knowledge there are a few experienced teachers of geography who will disagree with him, but even those who may fully agree that this is a first essential may strongly doubt the wisdom of the author's methods of inculcating it. There is an initial statement in the Preface which must not be allowed to go unchallenged. Defining "primer" according to the Oxford Dictionary as a "small introductory book," Professor Lyde makes the amazing statement that as yet no such book appears on the lists of any publisher. Surely this is an unnecessary slight on the small introductions, each excellent in its own way, of such authors as Newbigin, Howarth, Rudmose Brown, and Chisholm.

During a long and active career Professor Lyde has amassed a vast and varied store of geographical information. Upon this store he has drawn and has sewn together a patchwork of remarkable excellence. Here and there is a large and carefully embroidered fragment—he selects the forest and grassland environments for detailed treatment and ignores others—whilst many of the smaller fragments are of materials rare and unexpected. Indeed, to guess their origin—since there are no references of any kind throughout the book—would be an occupation of great, if prolonged, interest.

But however excellent the book, there are many who would urge, and amongst them must be numbered the reviewer, that they prefer a scheme in plain colours, be it ever so simple, or a design which is essentially systematic. Surely one of the greatest needs of the age is to think systematically and logically. As a famous economist said recently: too many men have minds like rag bags. Further, most examiners have cause to complain of "woolly," indefinite answers to questions, full of such words as "sufficient," "immense," and "important." Professor Lyde launches a severe attack against the use of statistics (he should have said misuse) and states, with truth, that they are practically out of date before they can be printed. Yet he himself uses statistics, on almost every page it seems, of the worst kind, unsupported by references by which they can be verified, incomplete and thus lacking in comparative value, and, worse still, without dates. It is unfortunately only too obvious how many are out of date—that North

America produces 85 per cent. of the world's oil (p. 130), that there are 75,000,000 sheep in Australia (p. 189). Then surely one must regret that a volume which sets out to put a geographical point of view should be without a single map.

L. D. S.

THE KENSINGTON STONE: a study in pre-Columbian American History. By HJALMAR R. HOLAND. *Ephraim, Wisconsin: privately printed* 1932. 8½×5½ *inches;* viii+316 *pages; illustrations and sketch-map.* $3.00

Within the limits available it is impossible to give an adequate idea of the close and cogent reasoning which Mr. Holand, as the result of more than twenty years' work on the problem, has brought to the rehabilitation of the runic inscription discovered near Kensington, Minnesota, as long ago as 1898. There is naturally a large measure of prejudice to be overcome: experts, acting, it would seem, on insufficient or erroneous information, have long ago pronounced the inscription a modern forgery, and its linguistic peculiarities, the improbabilities connected with the idea of a Scandinavian expedition in the heart of Minnesota in the fourteenth century, and, above all, the presence at the present day of a predominantly Scandinavian population, all give *primâ facie* colour to the notion that the inscription is a fake. For all that, such a theory is almost certainly untenable. The responsibility of the modern Scandinavian colony is disproved by a most conclusive alibi: the stone was discovered under the roots of a tree which must have been there during the whole period of its growth, and, even if we make a most liberal deduction for the errors of enthusiasm from Mr. Holand's calculation of the age of the tree, we are still left with a date earlier than that when the first Scandinavian pioneer arrived in the district. This point changes the aspect of the case fundamentally, for before 1860 the presence of a runologist in Minnesota is almost as unlikely as that of a Scandinavian expedition in the fourteenth century. Further consideration presents the hypothetical forger as a person of scarcely credible eccentricity. At the imminent risk of his life, for the district was infested with hostile Sioux, he spends quite two days carving an inscription of a length altogether superfluous for his purpose, and departing in almost every respect from easily accessible precedents. He is evidently a scholar, for he quotes correctly the mediaeval and not the modern Swedish version of the Lord's Prayer, and employs runic numerals so recondite as to baffle the local *savants* for years. Knowledge of these in modern times could be derived only from a rare seventeenth-century work written in Latin. On the other hand, the grammar and spelling are those of a quite illiterate person, a circumstance intelligible enough if the inscription be genuine, but inconsistent with any degree of modern scholarship. Further, though he knows, *ex hypothesi*, only of the voyages of Leif and Karlsefni in the eleventh century, he goes out of his way to substitute Swedes and Norwegians for Icelanders or Greenlanders, and to date his inscription as late as 1362. This date, and this personnel, Mr. Holand, by piecing together scattered hints, shows to be appropriate to an expedition despatched by King Magnus Eriksson, but such a theory is most unlikely to have occurred to any one at the latest date when a fabrication is possible, while the coincidences seem too close to be fortuitous. Finally, after all his trouble, the forger fades into the unknown, leaving the discovery of his work to a highly improbable accident.

These are only a few of the difficulties which the theory of forgery is shown to involve. On the other side, apart from the inherent unlikeliness of the presence of Scandinavians in fourteenth-century Minnesota, there remains really nothing but the linguistic objections. As to these, while form and usage undoubtedly conflict with the literary practice of the period assigned, Mr. Holand is able to produce precedent for every point assailed, and he argues with force that in the

colloquial speech of the time such irregularities are likely to have been even more common.

Finally, the author is able to produce a number of corroborative finds from the neighbourhood, which, if they are what they seem to be, are surely conclusive of the whole question. These include three Swedish battle-axes of the fourteenth century, accepted as such by the custodians of Scandinavian museums, and differing widely in type from anything found elsewhere. The circumstances under which these were found, attested in sworn affidavits, again make it impossible that they could have been introduced into the country by the modern Scandinavian colony. This part of the case certainly cannot be ignored.

It must be conceded therefore that the author has made out a case for the careful reconsideration of the current verdict, while, if the genuineness of the inscription is established, he will have added a chapter of unique interest to the story of the Norse exploration of America. G. M. G.-H.

ROME AND THE ROMANS: a survey and interpretation. By GRANT SHOWERMAN. *New York: The Macmillan Company* (*London: Macmillan & Co.*) 1931. 9×6 *inches;* xxii+644 *pages; illustrations and maps.* 21*s*

The object of this survey is to give an account of the life of the ancient Roman world. Its scope can best be gathered from the chapter-headings—The Roman: How he looked, the House in which he lived, the Women of his Family, What he ate and drank, the Senator, the Voter, the Lawyer, Letters and the Arts. The period covered lies principally between 100 B.C. and the death of Augustus. The author, who is Director of the Summer Session of the American Academy in Rome, is well qualified for his task, but he is clearly writing for readers or students of no very high attainments and is often positively naïve, as when he warns them that there was no tea or coffee in those days. He might have added to the interest of his book by drawing more frequent parallels between ancient Rome and modern Italy, as by pointing out the similarity of the shops at Pompeii to those in Naples to-day. Had he ever been within 50 yards of a school in a remote Southern village he would realize that Martial's description of the noise made by a schoolmaster was no more a caricature then than it is now. The Babel can still be wonderful. The book is profusely illustrated. Many of the pictures of restorations of important parts of ancient Rome are excellent.

L. C.-M.

## GENERAL

COLLECTED ESSAYS OF NAOMASA YAMASAKI. *Tokyo: Kokon Library* 1927–28. 2 *volumes.* 9×6 *inches. Vol. I,* viii+564 *pages. Vol. II,* vi+630+42 *pages; illustrations, portrait, and maps*

These volumes, mainly on geographical and geological subjects, together with original research in the field of seismology and volcanic phenomena, cover an extensive and varied area, and represent an exceedingly high standard of achievement. They are presented to the Society by Professor Yamasaki's widow, whom many of our Fellows will remember as the companion of her husband on the occasion of the International Geographical Congress held in London and at Cambridge in 1928. In her letter accompanying this valuable gift Mrs. Yamasaki explains that a further collection of similar papers is in preparation by some of her husband's former students in the School of Geography, with the object of forming a collection of representative writings of one of the most versatile and distinguished men of science Japan has produced.

A brief sketch of Professor Yamasaki's career was printed in the *Geographical*

*Journal* for January 1930. Perhaps his most important work, with which his name will always be associated in his own country, is his establishment of the School of Geography in the Faculty of Science in the Imperial University of Tokyo. Many of the papers included in the two volumes before us originally appeared in the form of lectures delivered at the University during the twenty years of his professorship, while others were given before the present Emperor of Japan when Heir Apparent. Several in the first instance formed contributions to such journals as *Petermanns Mitteilungen*, etc. Though the text is variously given in Japanese, German, or English, Mrs. Yamasaki has thoughtfully sent a full list of the titles in English, thus giving a clear idea of the scope of the subjects with which the collection deals.

The contents of Volume I include articles on Volcanoes, Geology and Geomorphology, and Glaciology. The first and third of these sections, in particular, embody original matter of great interest and value. In Volume II we have papers on Seismology (on which subject Professor Yamasaki was one of the greatest living authorities), Archaeology, and Anthropology, together with Human and Regional Geography, and Education in Geography. The portrait of the Professor and the sketches in the text add considerably to the interest of this acceptable gift.

W. W.

THE NORTHERN LANDS. By E. D. Laborde. (Cambridge School Geographies. Book VI.) *Cambridge: University Press* 1932. 8×5½ *inches;* xiv+298 *pages; illustrations and maps.* 3*s* 3*d*

That geography in schools should be used as an instrument of general culture, giving the pupil not only some knowledge of the world and of its inhabitants, but affording also a basis for the teaching of history, and offering some introduction to the physical and natural sciences, is now generally admitted. But such a view imposes upon writers of school books a task much more difficult than the older plan of merely boiling down larger texts. Of the present book we can only say that it represents an interesting experiment, the value of which must be estimated by the teacher using it in his classes. Within a limit of some 300 pages the three continental areas of North America, Asia, and Europe are dealt with, certain general geographical principles are laid down, and at the same time few, if any, of the topics subsidiary to geography fail to find some mention. This means, necessarily, great courage on the part of the author and much generalization, while it is natural that there should be not a few obscurities, as well as statements which may mislead those for whom the book is intended. But courage is a great quality without which no advance can be made, and it is much in evidence here. In a future edition some attempt should be made to indicate the scale on which the various sketch-maps are drawn. The stippling on the maps on pp. 172 and 227 might also well be reconsidered, since the two maps give a very different view of the height of the Ural Mountains and the nature of the Ekaterinburg Gate.

M. I. N.

WATER DIVINERS AND THEIR METHODS. By Henri Mager. Translated by A. H. Bell. *London: G. Bell & Sons* 1931. 9×5½ *inches;* x+308 *pages; illustrations.* 16*s*

During the War M. Mager was remarkably successful in locating underground water supplies for the French Army, and the success of his method is sufficient ground for giving respectful attention to this treatise on water-divining in general and the theory of the divining rod in particular. Sir William Barrett, in his book on the Divining Rod, published in 1926, dismissed all physical explanations of the unquestionable facts as unproved, and pronounced in favour of some

psychic perception on the part of the dowser; but M. Mager stoutly maintains that the movements of the divining rod are controlled only by external physical agencies acting through some form of radiant energy, probably electro-magnetic. It is difficult for most of us to grasp the exact nature of these researches into phenomena which British men of science have usually dismissed as unworthy of attention, and the difficulty is not diminished by seeing it through the veil of a translation, well as Mr. Bell has done his work. This journal is hardly a suitable arena for the critical discussion of problems of pure physics, yet we must point out that some of M. Mager's theories, based on observations, appear to suggest an explanation of the baffling facts concerning the directive properties of non-magnetic bodies which Mr. E. A. Reeves has long been investigating. We cannot accept M. Mager's views as the last word in the discussion of experiments with divining rods and non-magnetic compasses, but it seems to us that they are preliminaries to a real understanding, just as Sir William Crookes's early work on "radiant matter" was in effect a prelude to the discovery of the electron and modern radiology. M. Mager in his turn does not hesitate to invoke the electrons and protons of the atoms of water and of metals to explain the action of the divining rod. If he does not quite succeed, at least he has given a final blow to the old and easy explanation of the dowser's art as pure charlatanism. H. R. M.

GEOGRAPHY AND STAMPS. By KENT B. STILES. *London: McGraw-Hill Publishing Co.* 1931. 9½×6 *inches;* xii+330 *pages; illustrations.* 12*s* 6*d*

The title of this book is somewhat misleading. What may be called the "pukka" issues of postage-stamps of a country illustrate chiefly the political changes which have taken place since 1840. A representative collection of the last fifty years of the nineteenth century is an epitome of the *political history* of the time. During those years the keen stamp-collector was chiefly interested in perforations, watermarks, colour changes, errors in printing, over-printing, and the like. Towards the end of the century however stamp-collecting became commercialized. Many of the smaller states began to realize that money was to be made by frequent issues of "provisionals" and other stamps rarely used in the post because the issues were bought up by enterprising stamp-dealers whose numbers increased yearly.

'Geography and Stamps' deals chiefly with the later issues, and especially with those commemorating "jubilees," "centenaries," etc., in endless variety, most of the issues providing revenue for some specific purpose. The political changes after the Great War must have produced a large proportion of the eighty-three thousand stamps mentioned by the author. In Part I, Mr. Kent B. Stiles gives an interesting account of those commemorative stamps which illustrate the work of the early explorers, and also of some of the post-War political changes. On most of the pages are black-and-white photographic reproductions of the stamps described, but it is often difficult to find the illustration to which a description refers. Part II, with the pretentious title "The Pageant of the Nations," is a series of place-names, arranged alphabetically, with short notes on stamps connected with the names. The occasional reference to the "catalog" of a well-known stamp dealer is suggestive, and the reader may wonder whether the purpose of this book is really geographical. B. B. D.

# THE MONTHLY RECORD

## MEDALS AND AWARDS, 1932

His Majesty the King has been pleased to approve the award of the Royal Medals as follows: The *Founder's Medal* to Mr. H. G. Watkins, for his work in the Arctic Regions, especially as leader of the British Arctic Air Route Expedition; the *Patron's Medal* to H.R.H. the Duke of Spoleto, for his work in the Himalaya as leader of the Karakoram expedition of 1929. The Council have awarded the *Victoria Medal* to Professor A. P. Coleman, F.R.S., of Toronto, for his contributions to the Geography and Geology of Canada; the *Murchison Grant* to Dr. K. S. Sandford, Secretary of the Commission of the International Geographical Union on Pliocene and Pleistocene Terraces, for his personal work in that investigation during the past six years; the *Back Grant* to Mr. Hugh Clutterbuck, for his expedition to Akpatok Island; the *Cuthbert Peek Grant* to Miss Gertrude Caton-Thompson, for her investigations in the Historical Geography of Lake Moeris; the *Gill Memorial* to Dr. E. B. Worthington, for his studies of East African Lakes.

## THE REPORTS OF COLONEL FAWCETT

It was reported in several newspapers on March 15 that a Swiss named Rattin, described as a big game hunter or trapper, had called upon the British Consul-General at São Paulo and described to him how in September of last year he had found an elderly European detained by Indians, west of the Xingu and east of the Madeira, who had declared himself an Englishman, and asked him to report his situation to the Consul, and to "a farmer called Paget." Difficulties of language and the surveillance of the Indians made communication hard, and it is not clear that the Englishman gave his name or any evidence of identity.

At the Meeting of the Society on 21 March 1932 the President said: Fellows will expect me to say something of the rumours which have been in the papers of the supposed finding of Colonel Fawcett. So far as actual facts go I can tell you no more than you have seen in the press. I would call your attention, as a matter of great interest, to the notes which were written in the *Journal* in February 1928, and also to Mr. Dyott's paper which was published in 1929. You will see that General Rondon, a Brazilian who has immense interest in and sympathy with the Indians, accepts what is now reported with very great reserve. I am bound to say, after examining all the evidence that we can obtain, that I should be inclined to accept the fact of Colonel Fawcett being alive with equal reservation. Everything is possible, but it would not be right to encourage hopes on the slender evidence we have. If you look at the map you will see that the two rivers between which Colonel Fawcett is supposed to have been seen, the Xingu and the Madeira, are 750 miles apart, and the place where he was supposed to have been seen from where the Swiss prospector first reported him, that is at São Paulo in the south, is something like 1500 miles distant. Whatever is known to this Society will be placed at the disposal of those investigating the report, and Fellows will be told if anything transpires, for Colonel Fawcett was not only a Fellow of this Society, but a very distinguished one, and a Gold Medallist.

## GEOGRAPHY IN THE UNIVERSITIES

Within the last year three principal Universities of Great Britain—Cambridge, Edinburgh, and now Oxford—have recognized the growing importance of our science in the studies of the University by erecting their Readerships in Geography into Professorships. At Cambridge and Edinburgh this has given promotion to the holders of the Readership, and the services to their Universities of

Professor Frank Debenham and Professor Alan Ogilvie have thus been duly recognized. At Oxford the Reader in Geography, the late Mr. Beckit, had died before the Preamble of the Statute creating a Professorship was passed, in the early summer of last year, and the slow processes of completing the Statute and establishing a Board of Electors representing the various interests of the University and the College to which the new Professorship was to be attached were not concluded until the end of the year, when the University *Gazette* announced the vacancy and invited candidates to apply by January 30. The election was made on February 20, but announcement was delayed for certain formalities until March 18. The Society will have been gratified to see that the choice of the Electors has fallen upon Major Kenneth Mason, M.C., of the Survey of India, who received the Founder's Medal of the Society in 1927 for his connection between the surveys of India and Russian Turkistan through the Pamirs in 1913 and his organization and conduct of the Shaksgam Expedition of 1926.

## GLACIER-LAKES IN CUMBERLAND

The discovery by Dr. Bernard Smith and others of the former existence of a number of glacier-lakes on the western side of Lakeland is important from the light that is thrown upon the mode of withdrawal of the great Irish Sea ice-sheet from the Cumberland and North Lancashire coast-line. Dr. Smith some years ago found evidence for a glacier-lake at the head of the Duddon estuary and predicted that evidence would also be forthcoming for lakes near the openings of the Lake Country dales farther north. In a paper entitled "The Glacier-Lakes of Eskdale, Miterdale, and Wasdale, Cumberland; and the Retreat of the Ice during the Main Glaciation," published in the *Quarterly Journal of the Geological Society of London* (vol. lxxxviii, pt. i, 1932), he reviews all the testimony for the glacier-lakes in the lower parts of the dales named as based upon overflow-channels, lake deltas and beaches, laminated clays and sands, and miscellaneous fluvio-glacial or lacustrine deposits.

At the height of the main glaciation the glaciers nourished in the Lake District issued from the valleys and uniting as piedmonts advanced westward over the lower ground probably beyond the present coast-line, where they were opposed and joined by the Irish Sea ice-sheet moving southward from Scotland. At this phase the thickness of the ice was enormous, for it is stated to have totally submerged the Isle of Man and even the highest of the Lake Country fells, which incidentally reflects the magnitude of the snowfall in the moist climate of Britain under glacial conditions. When the ice began to retreat shrinkage took place both to the east and west so that the two fronts were again separated, and when the Lake District glaciers had retired up the valleys lakes were impounded at the mouths of the latter by the Irish Sea ice-front. The recession of the ice took place slowly from south to north so that Morecambe Bay was free of ice before the lakes of the Duddon estuary and of lower Eskdale, Miterdale, Wasdale, and Enerdale came successively into being. The lake in Wasdale was situated farther west than the present Wastwater, and uniting later with the lake in Miterdale, discharged through successive channels across Muncaster Fell which holds a commanding position and furnishes the key to many of the problems discussed.

In the discussion which follows the paper Professor P. F. Kendall, in paying a tribute to the value of Dr. Smith's results, emphasizes the significance of the Muncaster Fell drainage channels in affording clear proof of the separation of the two ice-fronts, and Dr. F. M. Trotter commented upon a similar split between the Cross Fell ice and the Lake District ice in the Eden Valley. Professor J. W. Gregory also welcomes the author's interpretation of the Irish Sea ice as of Scottish origin.

## THE DANISH ESKERS

A study by S. A. Andersen, of the University of Copenhagen, under the title of 'The Waning of the last Continental Glacier in Denmark as illustrated by Varved Clay and Eskers,' appearing in the *Journal of Geology* (vol. xxxix, no. 7, 1931), deals with the origin and significance of an extensive system of eskers in the basin of the river Susaa in the south-east of the island of Zealand in Denmark. The eskers occur in four valleys known as the Koege, Naestved, Mulstrup, and Haslev esker valleys, the last-named coinciding with the valley followed by the river Susaa above lake Tystrup. The theory said to be generally accepted is that these esker troughs were eroded beneath the Baltic ice-sheet by streams of summer melt-water during the period when the ice-sheet was still in motion, and that the eskers were deposited in them during the subsequent stagnation of the ice before it finally disappeared. The author further works out the relationship between the four chains of eskers, and shows with the aid of sketch-maps that the outstanding similarity in the succession of the different parts of each of the four valleys can be explained only on the assumption that the corresponding parts were developed contemporaneously. The eskers are arranged in a succession of bows, each containing the deposits of a single year, and were left along the retreating line of demarcation between the stagnant and moving ice, which can thus over a number of years be followed on the map by lines connecting contemporaneous bows.

The conclusion reached by the author on the evidence of the eskers and other glacial remains in Denmark is therefore that the ice remained as a stagnant body for many years before it finally melted away, and that moraines, formerly regarded as deposits of the ice border, were deposited beneath the ice along a line separating the moving ice from the stagnant ice whose outside border may often have been some 50 miles distant from this line. In Denmark, unlike some regions, the ice did not retreat as a wall leaving behind moraines. The author hopes to be able to correlate the Zealand deposits with those in neighbouring regions with a view to their actual dating.

## A CENTURY OF ICE-OBSERVATION IN DAVIS STRAIT

For many years the Danish Meteorological Institute has published yearly reports on the state of the ice in Davis Strait, derived from information supplied by seven or eight ships which each year have navigated those waters. The data so obtained now cover an unbroken period of rather over a century—1820–1930, and the main features are summarized in a brochure by C. I. H. Speerschneider, published by the Institute in 1931. Apart from the regular records, the writer has culled information from various sources—books of travel, etc.—and the tabulated information begins from 1579. For each year from 1820 a brief account of the state of the ice at different seasons is given, and finally the writer attempts a general estimate of the variations to be noted through the whole period. For this purpose he adopted a scale of marks for the amount of ice in each year, taking as criteria such facts as the greatest drift westward or northward, the number of months with any ice, or with an unusual amount of ice, and so on. Each month with ice thus had six different marks, and the mean value of the monthly marks was put down as that for the year. These yearly marks were then plotted to scale and a smoothed curve drawn in. The general result is to show that the periods 1820–1860 and 1900–1930 were poor in ice, while the period 1860–1900 showed greater abundance. Of all the years in which the main ice ("Storis") reached west of 55° W. nearly two-thirds (19 out of 30) fell within the periods 1830–1849 and 1880–1899. Since 1910 it has not reached so far west as before. The writer does not attempt any explanation of the causes of the periodicity thus brought out.

## THE ISSIQ KÖL

In 1928 and 1930 L. S. Berg led expeditions on behalf of Russian institutes to investigate the hydrography and biology of the Issiq Köl. He publishes an abridged account of the results in the *Zeitschrift* of the Berlin Geographical Society, 1/2, 1932, with a map of the depths recorded. The lake has an individual climate: regular winds blow off it by day, and down from the mountains by night. Each part has its local winds, which originate at no great distance from the shoreline. These local winds tend to equalize land and water temperatures. Though the upper air currents are western, the west end of the lake is considerably drier than the eastern, there being little condensation, and precipitation is caused by the higher mountains to the east alone. There is thus a marked contrast between the dry western end (100 mm. per annum) and the east (570 mm.). The maximum rainfall occurs in July, with a second maximum in May.

Soundings in the lake, mainly in the central portion, gave depths of up to 660 metres—and one of 702 metres was recorded. The greater depths were all near the southern edge, showing that this is probably a line of faulting. The salinity of the water is low (less than half that of the Aral Sea) and relatively constant. This would point to the lake having previously had an exit—and there is other evidence for this. The lake level had fluctuated in recent years: it was rising in 1901, falling in 1905, and rising again in 1928, though it was then 1·33 metres below its 1901 level. Apart from these variations, the lake-level has risen considerably in historic times, as the discovery of ruins below water-level, and the drowned river mouths, show. In the geological era the level was much higher: on the south-western shores there are series of terraces from 2 m. to 50 m. above the present surface. The lake must then have had an exit through the Chu river to the Buam gorge.

The flora and fauna are very poor, and cannot be compared with those of Lake Baikal. About 400 tons of fish are taken annually.

## JOURNEY TO THE HUKONG VALLEY, 1890

We have received from Colonel Harry Frere Loch a portion of his diary describing a journey made to the Hukong valley in 1890. He was then stationed at Kendat, on the Chindwin river, Upper Burma, and obtained leave to accompany the late Captain E. W. M. Norie, of the Intelligence Branch, on an attempt to reach the Hukong valley *via* the upper Chindwin, and Maingkwan, near reported amber mines. Leaving Kendat by launch they reached Kanti (Zingkaling Hkamti), the limit of navigation at that season, on October 30. From Kanti, to avoid the defile of the Chindwin, they procured coolies, and made a detour into the hills to the west, returning again to the Chindwin near Taro, after several days' marches. Partly by boat and partly by marching, they advanced into the Hukong valley to the junction of the main Chindwin stream (Nam Tanai), here coming from the south-east, with a large tributary from the north. Here, through the opposition of local chiefs, they had to abandon their project of going on to Maingkwan, and returned to the lower Chindwin by approximately the same route. They then went three days up river by boat to examine the rapids. They finally reached Kanti on December 12. Colonel Loch states that this was the first time the Hukong had been reached by way of the Chindwin, and this claim appears to be justified. The lower Chindwin was fairly well known from the journeys of British officers in the 'thirties of last century. Colonel R. G. Woodthorpe had surveyed it to its junction with the Uyu tributary. The Hukong valley had been visited in 1836 by Captain Hannay, who however entered it from the south-east by the Mogaung river. A year after Norie and Loch's visit, a column entered the

valley by this route, and the surveyor, Mr. Kennedy, reconnoitred about 4000 square miles.

Beyond a few sentences in the 'Gazetteer of Upper Burma' (pt. 2, v. 1, pp. 240–1) there is no reference to Norie and Loch's journey in the Society's Library. Colonel Loch's diary has therefore been deposited there for record.

## FLOODS IN EAST AFRICA, 1930

In the early part of 1930 great damage was done to the central railway of Tanganyika Territory by exceptional floods which destroyed bridges and made many breaches in the embankments. With a view to obviating such damage in future the nature and causes of the floods have been studied with great care by Mr. C. Gillman, Chief Engineer of the system, who has given the results in memoranda attached to the Annual Reports of the Tanganyika Railways for 1930 and 1931. As on previous occasions, Mr. Gillman shows himself a competent geographer as well as engineer, and he brings out well the practical value of considerations of physiography and geomorphology which some might regard as purely academic. The worst floods in 1930 came from the basin of the Mukondokwe, a stream which breaks out from the great East African scarp near Kilosa. In its lower middle course it flows in a deeply eroded valley, but higher up the valley is broader and bounded by broken hill country, all the tributaries from which are periodic, draining semi-arid ground. A step-like gradient results in three shallow basins, separated by short stretches of steeply graded ground, the basins forming lakes at times of exceptionally high water, each of them draining into the next below. The profile is that of a steeply graded young scarp-river continually cutting backwards, and causing a dangerous instability. The alignment here chosen for the railway has thus proved to have been a mistaken one, and reconstruction is needed. The lowest of the three lakes, known as Gombo, has shown great fluctuations during the past sixty years, having been at one period nearly empty, at another more or less full, and since 1919 floods have filled the lake at diminishing intervals and with increasing volumes, that of 1930 being one of the worst known. In that year there was an unusually heavy and prolonged rainy season all over the Central Province, but the floods in question must have originated in the upper basins above Gulwe, and it is suggested that they may have been intensified by the occurrence of the heaviest rains in the most arid part of the catchment, subject to sheet-flooding and the largest proportional run-off.

Another area which suffered in 1930 was that of the Usinge basin, traversed by the railway before reaching the Mlagarazi. It has been carefully examined and is shown to be encircled by higher ground all round except at the Sibwe gap, through which communication is maintained with the Sinde river, sometimes in one direction, sometimes in the reverse. The rainfall is extremely variable, and periodic flooding results. Mr. Gillman finds that an important factor is the formation of "sudd" during the *fall* of the water-level, causing a serious obstruction to the flow of the flood-water when it comes. Paradoxically therefore it is the dry periods which actually lead to the eventual flooding of the railway in this section. Some way of combating the formation of sudd is therefore called for.

## POPULATION OF CANADA, 1931

We have received through the agency of the High Commissioner for Canada the final figures of population by Provinces arrived at through the Census taken on 31 May–1 June 1931 by the Dominion Bureau of Statistics. A comparison with the figures for 1921 reveals some interesting changes. The total population is 10,374,196, an increase of over 1,500,000 over 1921; and all the Provinces,

except four, show percentage increases varying from 5 to 30 per cent. The very small population of Yukon Territory has grown by seventy-three persons, but Prince Edward Island, Nova Scotia, and the North-West Territories all register a decrease, in the last case of more than 10 per cent. Quebec has the largest numerical increase (513,056), closely followed by Ontario with 498,021; the biggest drop, only just short of 11,000, is recorded by Nova Scotia.

## EAST GREENLAND

An interesting private expedition to the east coast of Greenland was undertaken, during July and August last, by Miss Louise A. Boyd, of San Rafael, California, a Fellow of the Society. She chartered the Norwegian S.S. *Veslekari*, under the command of Captain Paul Lilleness, which, after a voyage up the west coast of Norway, left the Lofoten Islands on July 4 and arrived at Jan Mayen Island on the 8th, where, two days later, a landing was made at Great Wood Bay. After sailing round the island, the voyage was continued in a general north-west direction until the coast of Greenland was reached near Cape Hold-with-hope on July 17, after apparently meeting with no serious delay through the ice, which here frequently presents considerable difficulty. The ice edge was reached in about latitude 72° 30′ N. and longitude 14° W., and during July 13, 14, and 15 the vessel was navigated through the ice in favourable conditions. On arriving at the coast of Greenland the vessel proceeded up the principal fjords between Cape Hold-with-hope and King Oscar Fjord, and then along the coast from Scoresby Sound to Pendulum Island. This fjord region was surveyed by the Cambridge Expeditions of 1926 and 1929 under the direction of Mr. J. M. Wordie, and an account of this work, with a map, was published in the *Geographical Journal* for June 1930. One result of Miss Boyd's *Veslekari* expedition is that new surveying was carried out at the head of Dicksons and Kjerulf Fjords, which, though small in extent, is an interesting addition to the work done by the Cambridge Expeditions. Throughout the voyage a careful record was kept of the air and water temperatures each day at stated hours. Miss Boyd has presented to the Society track charts of the expedition, with a copy of the temperature records.

## A NEW SETTLEMENT ON THE PARANA

We have received from Mr. A. J. Schwelm a copy of a lecture delivered by him at the Royal Institute of International Affairs on the foundation and progress of the settlement of "El Dorado," in the Misiones territory of the Argentine. The settlement is also described by Mr. Kenneth Lindsay in a pamphlet 'El Dorado: an agricultural settlement,' 1931. It is on the left bank of the Parana, about 70 miles south of the Iguazu falls, and 130 miles from Posadas. Mr. Schwelm bought here in 1919 a tract of forest land, about 400,000 acres, of which one-fifth has now been cleared, and started a scheme for its colonization. Clearing was begun, with the aid of native Guarani labour, and plans for securing settlers initiated. The first group were twenty-six Danes from the Argentine; the number of settlers has now grown to 7000. Intending colonists are interviewed at Buenos Aires, in order that only those suitable shall be admitted. The chief nationalities represented are Danes, Germans, and Swiss. The latter have embarked successfully upon dairy farming. The scheme is organized on individualistic and competitive lines, and arranged to make each settler independent as soon as possible. After clearing the holdings with native help, the settlers plant maize, manioc, vegetables, etc., to support them while establishing the plantation crops upon which the prosperity of the settlement must depend. The principal exports are cultivated yerba (maté), tobacco, citrus fruits, and timber. In 1930 the value of exports were £150,000. An experimental farm has been established, and many

species of trees and plants introduced—Mr. Lindsay's pamphlet contains a list of the introduced species and the result obtained. The settlement now boasts six schools, several churches, stores, and a wireless station.

### THE HOMEM CHARTS OF THE SIXTEENTH CENTURY

We have received from Professor S. Crinò, a well-known Italian authority on early maps, an interesting paper, issued as a supplement to the March 1932 number of the *Rivista Marittima*, on the subject of the nautical charts bearing the name of Lopo Homem, one of which previously undescribed was dealt with in the *Journal* for March 1931, with facsimile reproduction. It was there pointed out that the only easily accessible map bearing the signature Lopo Homem was the fine specimen dated 1554, preserved at Florence, but that another had been known to exist in Italy, though lost to sight in recent years. By careful inquiry and search Professor Crinò has succeeded in tracing this in the Library of the Duke Salviati di Migliarino at Pisa, and a reduced facsimile accompanies his paper. (The map was first described by F. Borghero some fifty years ago, but having no special knowledge of early maps, this writer's conclusions as to its date, etc., were erroneous.) While the large map of 1554 embraces the whole world, this undated specimen resembles the portolan charts in showing only the basin of the Mediterranean with parts of the Atlantic coasts of Europe and North Africa. It measures 59 × 90 cm., and in its general style resembles the map of 1554. Professor Crinò holds that this map strengthens the grounds for believing, as was suggested in our article, that there were two Lopo Homems, of two generations, the elder being the official cartographer who worked at Lisbon in the early part of the sixteenth century, and was the author of the map sold at Sotheby's in 1930. The genuineness of this, called in question by Sig. Caraci, he fully accepts, reproducing the half-scale facsimile given last year in the *Journal*, as well as the big map of 1554 (on a larger scale than the version brought out by Sig. Caraci); so that the whole of the known output of the two Lopo Homems can be studied and compared. One or two other contemporary charts are also reproduced, one, hitherto undescribed, being by the well-known cartographer Giacomo Maggiolo. It covers almost the same area as Lopo Homem's smaller map, though its date of 1 May 1565 puts it considerably later, for Professor Crinò sees reason for thinking the smaller map to be earlier than 1554. It should be noticed that Professor Crinò entirely dissents from Dr. Wieder's theory that the 1554 map closely followed the lost map of Alonso de Chaves. One coming much nearer this (judging from the description of it given by Oviedo) is another specimen in the Laurentian Library, originally owned by Cardinal Salviati, a section of which forms one of the present reproductions.

## CORRESPONDENCE

### ISLAND ARCS AND MOUNTAIN BUILDING

The paper by Mr. Philip Lake which was published under this title in the *Geographical Journal* for August 1931 is of the greatest interest to all geologists who are concerned with the structure of Asia. In particular, Mr. Lake's method of determining the dip of the fundamental planes of movement in certain mountain chains may prove to be of great practical assistance. In determining a pole for the Iranian Arc however Mr. Lake has set rather arbitrary limits. It is at least extremely probable that the south-west Iranian orogen continues with substantially the same structure through Baluchistan to join the Himalaya and

through Kurdistan into the Taurus. The selection of particular portions of a sinuous orogenetic zone for application of these methods seems hardly justifiable.

K. WASHINGTON GRAY

*Masjid-i-Sulaiman, South Persia.* 4 *March* 1932.

The structure of south-western Asia is so complex and so imperfectly known that the exact application of the methods outlined in my paper is not yet possible, and approximations may lead to incorrect conclusions. But my circular "Iranian arc" seems to have rather more significance than Mr. Gray allows. Owing to some oversight on the part of the draughtsman it is not completely shown in the published map. It skirts the Mesopotamian plain, the Persian Gulf, and the Gulf of Oman, and throughout the greater part of its course, some 1500 miles, it conforms very closely with the geological and topographical features. My own doubts about its value arise from the disturbances in the Bandar Abbas area, where the relationship of the Oman folds to the arc is curiously like that of the Shichito volcanic line to the Japan arc. Moreover, towards the east it is evident that the rigid mass of Peninsular India has had a marked influence upon the direction of the folds. We cannot, in fact, expect such regular circular arcs here as on the east side of Asia. There the foreland is the comparatively uniform floor of the Pacific; here the foreland is made up partly of upstanding masses like the Indian Peninsula, partly of ocean-floor.

Mr. Gray refers to the Taurus arc. Its pole lies far from the great circle shown on my map. The inference suggested is that, so far as this orogenic belt is concerned, the Russian Platform has behaved as a separate unit, independent of the "Asiatic mass" of my paper. But this does not in any way imply that the Taurus does not belong to the same belt as the Iranian arc. All that my method does, even when the data are complete, is to analyse the movements which produced the orogenic belt.

PHILIP LAKE

## MEETINGS: SESSION 1931–1932

Tenth Evening Meeting, 21 March 1932. The President in the Chair

*Elections:* Capt. T. W. Butt-Thompson; Miss Ethel Franklin Cartwright; John Watson Catlow, B.A.; The Rev. James Edwin Cresswell; Henry Clifford Darby, PH.D., M.A.; The Rev. Roger Hugh de Pemberton, M.A.; Thomas John Eastwood; Mrs. Bramley Firth; Arthur Philip Gray; Miss Margaret Evelyn Gray; Reginald G. Lewis; Mrs. Edith Mackworth-Praed; Miss Muriel Mary Middleton, B.A.; Mrs. Faith Cope Morgan; Charles Victor Porter; Edgar William Rees; Brian Birley Roberts; Alfred Stephenson; Edward Austin Waters; Mrs. Margaret W. Waters.

*Paper:* The Coral Coasts of India. By Lt.-Col. R. B. Seymour-Sewell

Additional Evening Meeting, 4 April 1932. The President in the Chair

*Paper:* The Humboldt Current and the Peruvian Coast Islands. By Dr. R. C. Murphy

Eleventh Evening Meeting, 11 April 1932. The President in the Chair

*Elections:* James Allgood; D. Falkland Cary; Montague Ewart Driver; Frank B. Foster; Leslie Garth Fothergill; Miss Ursula Mary Matthew; Jai Narain; Edward George Netscher; Miss Barbara Norwood, B.A.; Edward J. Pohlman, A.B.; Lt.-Col. Harold St. Clair Smallwood; Lt.-Commr. Arthur Daveney Steele, R.N.R. (Rtd.); Roger Thomas, B.SC.; Harold W. Whitbread, M.R.S.T.

*Paper:* Kangerdlugsuak and Mount Forel. By Mr. A. Stephenson

Southern Greenland, showing th

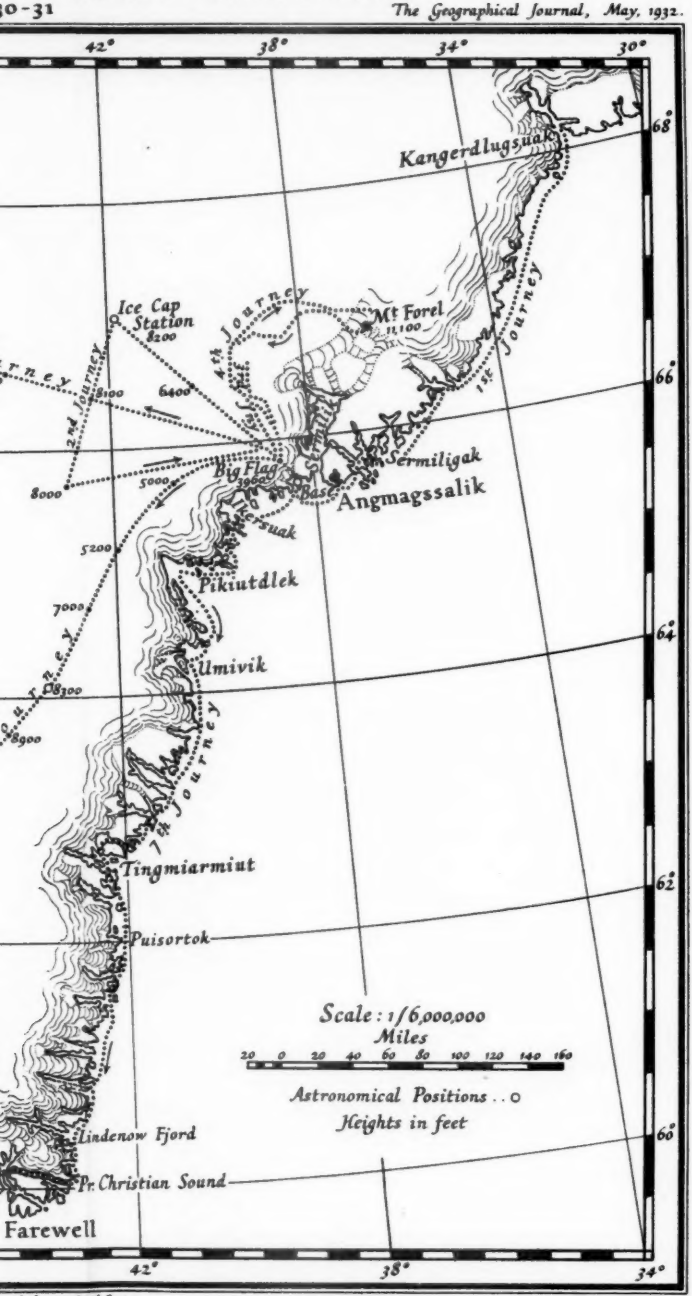
THE BRITISH ARCTIC AIR RO

1930-31

Published by the Royal Geographical

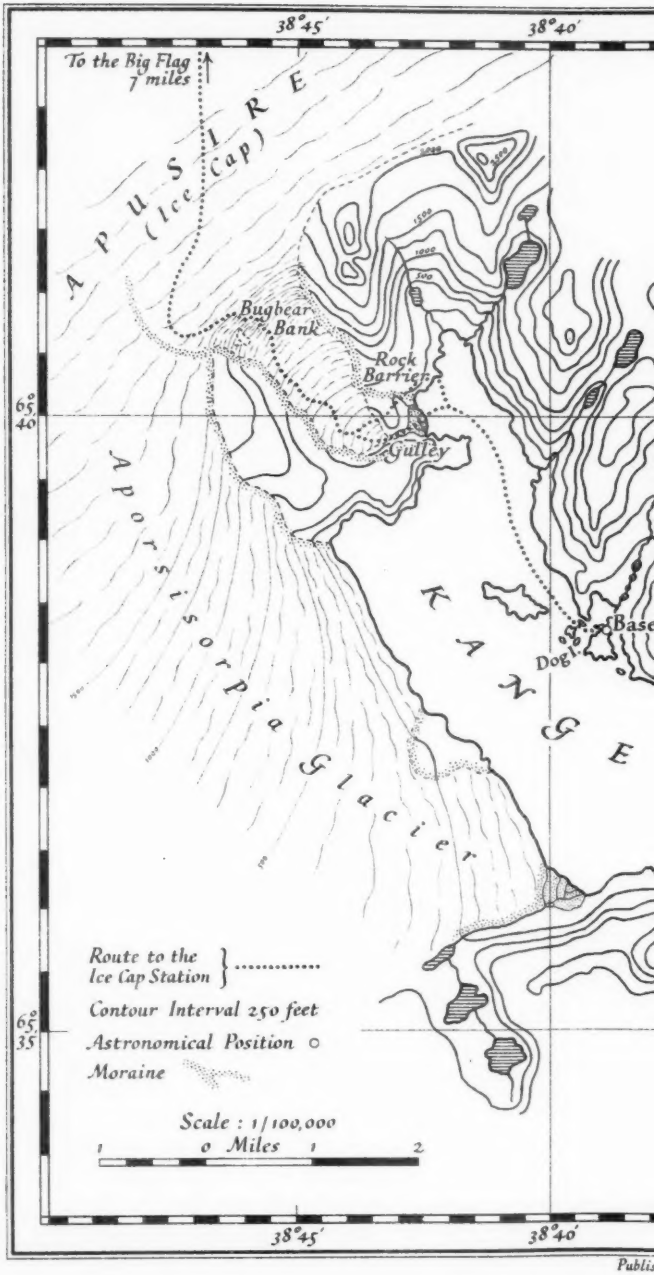
wing the Seven Journeys of
IR ROUTE EXPEDITION
30-31



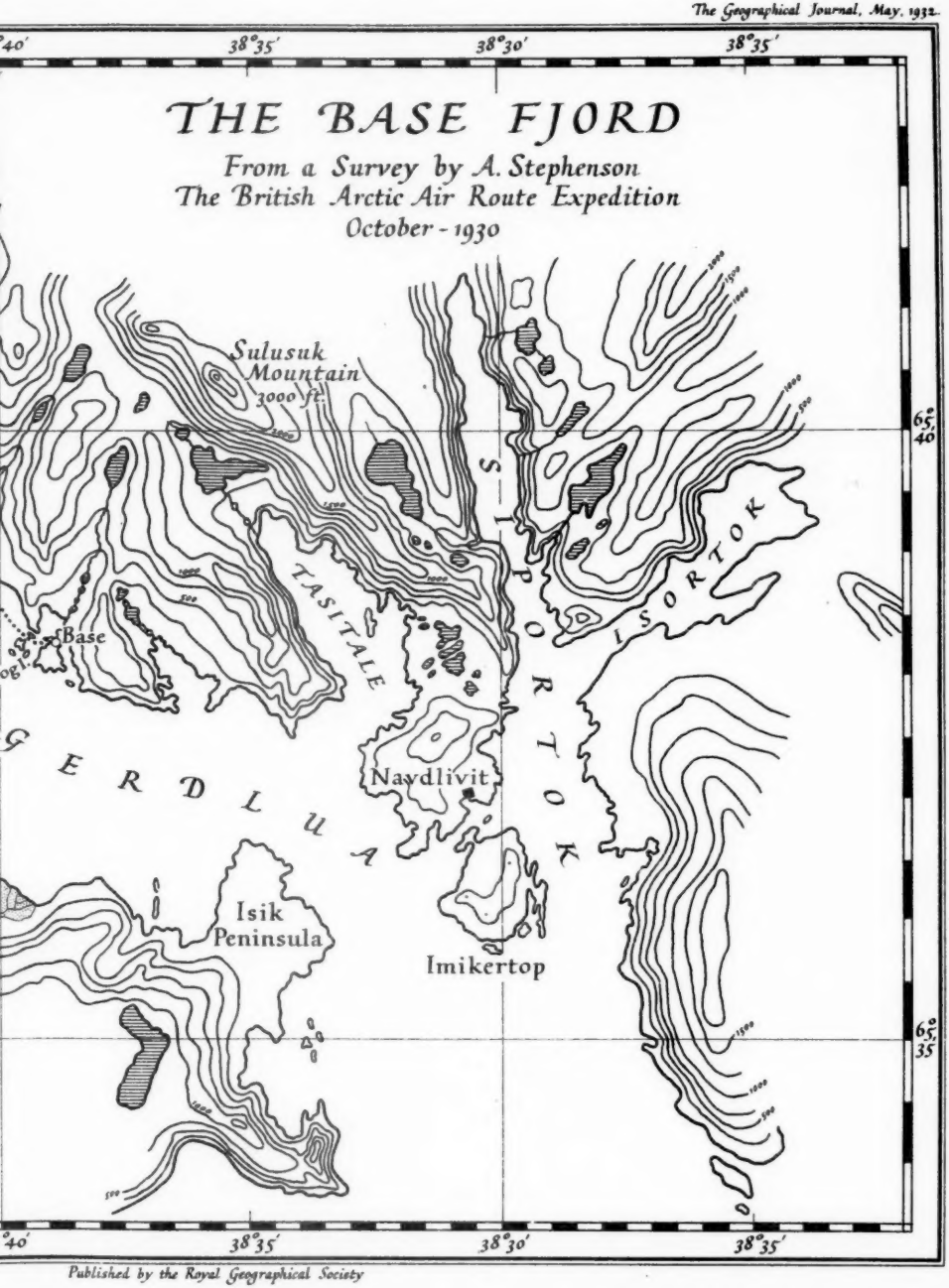



oyal Geographical Society

GREENLAND
British Arctic Air Route Expedition


38°45′
38°40′
To the Big Flag
7 miles
APUSIRE
(Ice Cap)
Bugbear
Bank
Rock
Barrier
Gulley
65°
40′
Aporsiorpia Glacier
KANGE
Base
Dog
Route to the
Ice Cap Station
Contour Interval 250 feet
Astronomical Position
Moraine
65°
35′
Scale : 1/100,000
1 0 Miles 1 2
38°45′
38°40′

Publis




Published by the Royal Geographical Society

GREENLAND
British Arctic Air Route Expedition